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A TEST FOR EXTRANEOUS MATTER IN CHEESE

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The requirements of the Federal Food and Drug Administration have stimulated the interest of the cheese industry in methods of detecting extraneous matter in cheese. Greene[2] has described a method which works well on some types but is somewhat slow in dissolving hard and semi-hard types of cheese. A satisfactory sediment test should make it possible to remove foreign material from American or Brick cheese without altering materially the physical condition and appearance of the extraneous matter which might be in it. Such a test to be of value in practical control work should be effective with cheese two weeks old. Rapidity and ease of performing test and low cost of materials and equipment are highly desirable. The study was undertaken to attempt the development of a test with these characteristics.

First, it was necessary to determine the influence of the size of cheese particles, the type of filter, speed and type of agitation of the cheese with the solvent, type of solvent, concentration of solvent, temperature and time of exposure to solvent action, and the age of the cheese. Finally, after the most suitable conditions and solvents for cheese dispersion were determined, various materials which might possibly contaminate cheese were subjected to these treatments. Some of the substances exposed to such treatments were flies, cockroaches, human hairs, cow hairs, broom splints, brush hairs, cloth, copper and wood splinters. Many of the solvents were eliminated because of their effect upon foreign material.

The size of the cheese particles was varied from ¼-inch cubes to the mass resulting from the use of a regular meat grinder. A kitchen type food grinder eventually proved most satisfactory for macerating the cheese. The knife was removed from the grinder so that the cheese was simply forced or crushed through the perforated end plate. Foreign material retained its identity when this method was used.

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[1] Industrial Fellow on a grant of the Kraft-Phenix Cheese Corporation.

[2] Greene, W. S. A method for the detection of extraneous matter in cheese. Cheese Reporter. March 21, 1936.

ing the lag phase of growth is an excellent example. From the standpoint of measuring the true bacteriological condition of the milk, this is a decided advantage, particularly with reference to probable keeping quality. On the other hand, from the standpoint of indicating the *number* of bacteria present, this is a disadvantage, and would be considered a source of error. Consequently, it is believed that the reduction test should be regarded, not solely as a measure of bacterial numbers, but rather as an index of the bacteriological *condition* of the milk, since this would include *activity* as well as *numbers*.

Of the various factors listed above which tend to influence the results of the reduction test there is an important one which can readily be eliminated. Various workers have shown that when the fat (and accompanying bacteria and body cells) is prevented from accumulating at the surface by homogenization, addition of agar or rennet (24, 32), or is redistributed at intervals by inversion or shaking (8, 16, 21, 24, 29, 32), decolorization is uniform, reduction time is usually shortened and marked variations between replicate tubes tend to disappear. This is most noticeable with milks containing few bacteria. Wilson (32) has therefore recommended a modified test, the main feature of which is the inversion of the tubes at half-hourly intervals. This has been adopted in England as the official method for the grading of raw milks. Thornton (28, 29), on the other hand, has recently opposed the adoption of this modification on the grounds that (a) the accuracy of the test is not significantly increased thereby, and (b) the technic is complicated unduly. Although the greater variability of standard reduction times of replicate tubes is freely admitted, the question is raised as to whether such variability is an adequate measure of the relative accuracies of the standard and modified reduction tests.[5]

It should be emphasized at this point that Thornton regards the reduction test purely as a measure of initial bacterial content. As such, he considers that the errors inherent in the test are of such magnitude that the significance of variations in standard reduction times of replicates, or differences between standard and modified reduction times, is difficult to evaluate. Even when the test is regarded in the above light it is difficult to accept the view that the errors introduced by creaming in the standard test are not of sufficient importance to warrant their elimination through a slight change in technic. As previously indicated, however, the test is primarily a measure of bacterial activity as indicated by oxygen consumption. The assumption that such a test is inaccurate unless there is perfect agreement between bacterial activity and bacterial *numbers* appears to be unsound and unwarranted. While it is true that certain workers, particularly those engaged

[5] The term "standard reduction test" refers to the test as officially described in the Standard Methods of Milk Analysis, 6th Ed. (1). The term "modified reduction test" indicates that the tubes are inverted at regular (half-hourly or hourly) intervals during incubation.

in official milk control, have tended to regard the reduction time as a quantitative measure of the bacterial content of the milk at the start of incubation, it is believed that the majority would agree with the view expressed by Hastings *et al.* (12) more than 15 years ago: "From many points of view the bacteriologist is chiefly interested in those organisms which are actually growing in milk. It seems probable that the methylene blue reduction test, because it is influenced by these relationships, measures more accurately than does any other method the bacterial activity in the milk."

When the test is regarded as indicating the bacteriological *condition* of the milk, rather than the initial bacterial content, then the basis for Thornton's first objection disappears. As an index of bacterial activity, the modified test undoubtedly possesses a significantly higher degree of accuracy than does the standard test. An accurate determination of the true rate of oxygen consumption is obviously impossible if varying proportions of the bacteria are permitted to concentrate at the surface in the cream layer. Such organisms are unable to affect the oxygen tension of the main body of the milk. The remaining bacteria take longer to consume the oxygen, while there is often irregular decolorization of the dye and poor agreement between replicate tubes. These features virtually disappear when steps are taken to maintain the bacteria in a more uniform state of dispersion. That the small amounts of extra oxygen incorporated in the milk by periodical inversion are of no significance is shown by the excellent agreement between reduction times of homogenized milks by the standard and modified tests (24, 32). It is evident, therefore, that the modified test measures the rate of oxygen consumption with significantly greater accuracy than does the standard test.

In a recent publication (28) Thornton states, "A coefficient of correlation between the results of the standard and modified methylene blue reduction tests calculated for 332 market milks of many classes was found to be 0.94 ± 0.004. Consequently neither test greatly excels the other in accuracy, despite the greater variability displayed in the standard test which may lead to inaccuracy in evaluating an individual milk." The argument advanced here is obviously refuted by the statement in the final clause. If the standard reduction times for individual samples are variable and inaccurate, as Thornton admits, while modified reduction times are not (8, 16, 24, 29, 32) then the two tests cannot be equally accurate. The high coefficient of correlation reported is entirely beside the point, since this is obtained by averaging the results from 332 different milks. It tells absolutely nothing concerning the relative reliability of single tube determinations on *individual* milks, the point in which the analyst is interested. It is therefore difficult to avoid the conclusion that the modified test, with its extremely close agreement between the individual and mean values for a series of replicates, must be regarded as significantly more accurate and reliable than the standard test.

Frayer (8) has recently reported comparative studies with the standard and modified technics using 50 to 100 replicate tubes with each method. His results emphasize the inherent unreliability of the standard method. He points out that if single or duplicate tests had been made on these milks by the standard test it would often have been impossible to predict in which of two or more classes they might have been placed. This point deserves more consideration than it has received heretofore; since in routine testing only single tubes are set up, it is highly important that the method employed yield dependable results. A further illustration of the effect of variations in the standard test upon the classification of milks is afforded by the present

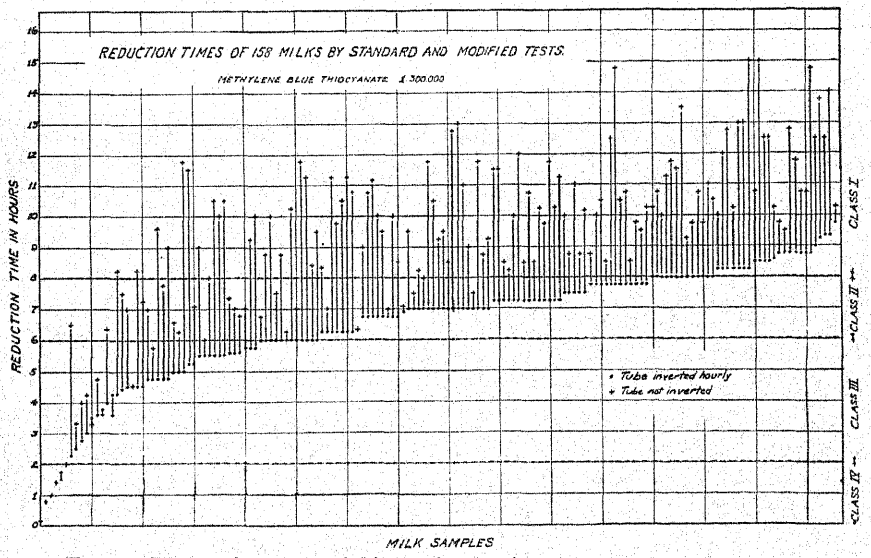

FIG. 1. Illustrating the variability of reduction times by the standard test.

author's data on 158 milks as presented in Fig. 1. Duplicate tubes were incubated together in the absence of light, one of each pair being inverted hourly,[6] the other left undisturbed. Since the modified test furnishes the more accurate and dependable indication of bacterial activity, the modified reduction times have been arranged in ascending order of magnitude and the corresponding standard reduction times plotted against them to show the degree of variability encountered. It will be seen that in the standard test there are wide variations in reduction time for milks showing identical reduction times by the modified test. For example, standard reduction times for the 12 samples reducing in 6 hours by the modified test range all the way from $6\frac{1}{4}$ to $11\frac{3}{4}$ hours. Recent findings in this laboratory suggest that such wide

[6] Studies to be reported in a subsequent paper had shown that there was no significant difference in reduction time between half-hourly and hourly inversion. Thornton (29) reports similar findings with 4 samples studied.

differences are not due entirely to the variability shown by replicate tubes in the standard test. As the data in Table 1 indicate, high grade milks from certain herds consistently show greater differences between standard and modified reduction times than do milks of similar quality furnished by other herds. The available evidence indicates that this is associated with the depth of cream layer and the rate of creaming during incubation. It would appear, therefore, that attempts to convert standard reduction times to corresponding modified reduction times according to the equivalent values[7] suggested by Thornton (29) would penalize some shippers while unduly favoring others. It is believed that these inherent differences furnish an added reason for the adoption of the modified test.

In addition to the lengthening of reduction time as milk supplies improve, there are several other considerations which increase the urgency of the need for a more reliable test. The first of these is the proposal to raise the limit for Class I milks from 5½ to 8 hours in the forthcoming 7th edition of Standard Methods of Milk Analysis. Since all investigators agree that the standard test becomes less reliable as the reduction time increases, this extension of the time limits will doubtless result in more serious errors in grading than under the old standards.[8] The reliability of the modified test, on the other hand, is not affected by the lengthening of reduction time. The second is the proposal to increase the dye concentration from 1:700,000 as now employed to 1:300,000 (26). Thornton and Sandin (26) report that with the higher dye concentration, reduction times are lengthened on the average by 30 minutes. Frayer (8) finds an increase in reduction time of the order of 100 per cent with the stronger dye concentration.[9] In the present studies it has been found that the increase is not a fixed increment for all classes of milk as reported by Thornton and Sandin but amounts to about 20 per cent of the reduction time. Data presented in Fig. 2 from comparative tests with single tubes inverted hourly illustrate this. While there are some exceptions, the general trends of the two curves show good agreement, the spread between the two sets of values widening as the reduction time lengthens. Since the bacteria were maintained in fairly uniform dispersion by hourly inversion, the occasional departures from the average are unlikely to be due to creaming.

[7] The equivalent values suggested are:

Standard reduction time	*Modified reduction time*
8:00	6:00
5:30	4:00
2:00	2:00

[8] In expressing the view in 1930 (16) that the standard reduction test was reasonably accurate up to 10 hours, the author had in mind its accuracy compared with that of the plate count in the examination of better class milks. Thornton (29) apparently holds the same opinion. It cannot, however, be regarded as equivalent in accuracy to the modified test beyond the first few hours.

[9] As subsequently mentioned, the technic adopted by Frayer may be responsible for the unusually great increase reported.

TABLE 1

Standard and modified reduction times of consecutive samplings from certain herds

Shipper's number	S	M	S	M	S	M	S	M	S	M	S	M	S	M	Ratio $\frac{S}{M}$
1 N	12:15	6:45	15:00	8:30	9:15	6:00	8:45	6:15	15:00	7:30					1.72
P	6:30	4:00	11:45	6:00					6:45	5:30					1.61
2 N	10:00	5:30	10:15	5:00	10:00	5:45	8:15	4:00	9:15	5:00	6:45	5:30			1.77
P	8:30	4:00	3:15	2:40	6:45	3:30			4:45	2:45	8:00	4:40			1.78
3 N	15:00	8:15	13:00	6:45	12:45	7:00	10:15	6:45	11:30	8:30					1.68
P	10:10	6:30	8:15	5:15	12:00	5:15			12:00	7:00					1.57
4 N	13:00	8:15	11:45	5:30	11:45	7:00	10:45	5:45	11:15	6:15	10:00	6:00	14:00	4:40	1.90
P	3:15	2:40	1:40	1:30	2:50	2:00	1:20	1:20	8:15	3:45			2:30	2:00	1.49
5 N	11:15	6:15	10:15	5:00	10:45	6:00	9:15	5:15	11:00	7:00	11:00	6:45	7:45	4:15	1.76
P	3:45	2:00	1:30	1:20	2:50	2:10	1:10	1:10	7:00	4:00			2:00	1:30	1.50
6 N	8:00	7:00	5:15	4:15	8:30	7:00	5:45	4:45	10:45	8:45	12:00	10:15	6:30	5:15	1.20
P	4:45	3:45	2:40	2:40	7:00	4:45	2:50	2:10	7:15	5:00			5:30	3:00	1.40
7 N	6:15	6:00	7:15	5:30	8:30	8:00	8:00	7:00	9:15	8:45	7:00	6:15	3:15	3:15	1.11
P	1:20	1:20	1:00	0:50	5:30	5:00	4:00	4:00	4:45	4:45			1:00	1:00	1.05
8 N	6:45	6:00	7:00	6:45	8:15	7:15	9:30	7:30	9:45	8:00	8:30	7:15	7:15	5:00	1.19
P	3:30	3:30			4:10	4:30	2:40	2:00	4:00	3:45	7:30	5:15	4:45	3:00	1.20
9 N	8:15	7:00	7:30	6:15	8:30	7:45	7:15	6:30	13:45	9:15	6:00	5:15	2:30	2:15	1.21
P	3:45	3:40	2:00	2:00	6:15	5:15			10:15	7:15			1:00	0:45	1.23

N.B. S = Standard Reduction time. M = Modified Reduction Time. N = No Preliminary Incubation. P = Preliminary Incubation at 12.8° C. for 18 hours.

It is more probable that differences in dye sensitiveness of the milk flora may be the cause.

At this point, mention should be made of some anomalous results encountered in 1934 when collaborating with Dr. H. J. Conn, Chairman of the Commission on Standardization of Biological Stains, in the testing out of the new methylene blue thiocyanate. With certain samples the modified test led to significant lengthening of the reduction time with the higher dye concentrations. This was not noted where the standard test was employed.[10]

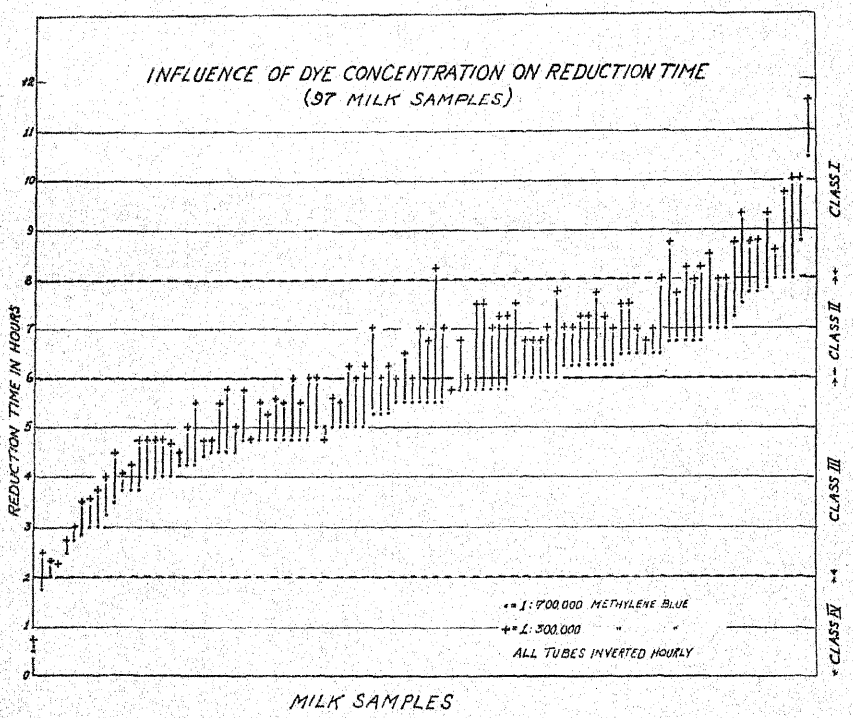

FIG. 2. Corresponding reduction times of 97 milk samples with old and new dye concentrations.

Similar cases have been encountered only twice during the present studies covering several hundred samples. Such cases would appear therefore to be too infrequent to deserve special consideration.

In passing, attention should be called to the fact that there is a much more satisfactory agreement between the modified reduction times with the two different dye concentrations (Fig. 2) than is the case with the standard and modified reduction times at either dye concentration (Fig. 1).[11] It will

[10] Thornton (30) has encountered two samples giving similar results.

[11] Results almost identical with those shown in Fig. 1, were obtained where a dye concentration of 1: 700,000 was employed.

also be noted that with the exception of Class IV milks the increase in reduction time resulting from the stronger dye concentration is considerably less than the average increase where creaming is permitted to take place. The mixing modification therefore more than compensates for the delayed reduction with the stronger dye concentration.

A further reason advanced by Thornton (29) for rejecting the modified test is that "it complicates the operation of the test to the extent that strictly uniform technic would be improbable in the hands of some who are at present satisfactorily performing the test." This was originally interpreted as referring to the *technic* of inverting the tubes but in commenting on the original draft of this paper Thornton (30) indicated that he had in mind (a) the difficulty of getting operators of the test, who often have various other duties to perform, to invert the tubes every hour, and (b) the test will have doubtful application in cheese factories, etc., if it is made the least bit more complex. Concerning the first point, it has been found in the present studies that any program of inversion, no matter how irregular the intervals, will increase the reliability of the test.[12] The slight inconvenience involved in periodical inversion of the tubes appears to be more than compensated for by the shortening of reduction time, simpler end-point determination, and greater reliability with the better grades of milk. As to the second point, the mixing modification is least valuable with the poorest grades of milk. For the ordinary run of cheese milks it will probably make little difference if inversion is omitted. On the other hand, where the test is used as the basis for premium payments for the best milks,[13] the more accurate technic should be employed. In the interests of uniformity and accuracy, therefore, it would seem desirable that the modified test replace the present technic for all classes of milks.

TECHNIC OF DETERMINING THE END-POINT IN THE MODIFIED TEST

Most investigators have recognized that reincorporation of oxygen immediately prior to reduction may unduly prolong the reduction time of certain milks and have modified their technic accordingly. Wilson (32, p. 216) specifies that "Any tube at the time of examination showing obvious signs of reduction should not be inverted, but should be left until the end-point as defined is reached." Thornton (30) employs a similar procedure, as does the present author. Frayer (8) does not state his procedure. That some judgment must be exercised by the operator of the test in deciding when to stop inverting the tubes is admitted. It is believed, however, that the difficulties involved are no greater, and probably far less, than those involved

[12] Thornton's own data (29, Table 6) show marked improvement resulting from inversion of tubes at the 4th, 6th and 8th hour of incubation.

[13] A program for improving cheese milk supplies along these lines is being considered at present in Wisconsin.

in attempting to estimate the end-points of the majority of better-class milks under the standard technic, where patchy and uneven decolorization of the dye is often encountered.

The method of determining the exact end-point with the reduction test is deserving of further study. Most investigators have worked out a technic for reading the end-point which satisfies them. That employed by the author is similar to that described by Wilson (32, p. 231), who remarks that "the point of 'complete reduction' of methylene blue is impossible to measure either visually or electrometrically." Frayer (8) on the other hand states that he has taken the point of complete reduction by transmitted light as the end-point but gives no details of his method. It seems not unlikely that this may be responsible for some of the differences between his results and those of other workers in comparing different dye concentrations, particularly if tubes were inverted without regard to incipient reduction.

SUMMARY

1. The methylene blue reduction test is based upon the rate of oxygen consumption in the milk by the bacteria present during incubation. This rate cannot be measured with reasonable accuracy where varying proportions of the bacteria are removed from the main body of the milk during the creaming process.

2. The accuracy of the test is greatly increased by periodical inversion of the tubes during incubation. In addition, reduction time is generally shortened and decolorization is more uniform, especially with the better grades of milk.

3. It is believed that these advantages more than compensate for the slight inconvenience entailed by this modification.

4. Milks showing similar reduction times by the modified technic sometimes show wide differences in standard reduction times. These appear to be associated with differences in the degree and rate of creaming.

5. Reduction time is prolonged by approximately 20 per cent with the proposed stronger dye concentration. This is more than compensated for in all but the poorer grades of milk by the shortening of reduction time when inversion is practised.

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THE INFLUENCE OF ACIDITY VARIATIONS DURING MANUFACTURE ON THE QUALITY AND RATE OF RIPENING OF BLUE OR AMERICAN ROQUEFORT CHEESE

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The limits of desirable acidity development at the various stages in the manufacture of cheddar cheese have been established by the results of numerous investigations. Comparatively little of such information is available to the manufacturer of Blue or American Roquefort cheese. No mention is made of acidity control in the reports of the methods used in France in the manufacture of Roquefort cheese (1, 2, 3). Funder (4), working in Norway on a modification for making Roquefort type cheese from cow's milk, recommended the addition of 2 to 2.5 per cent culture in order to secure mold vegetation. He considered a high acidity necessary for abundant growth of the penicillium.

Thom and Matheson (5) have given the subject considerable attention. According to their experiments cow's milk should be brought to an acidity of about 0.23 per cent by the addition of starter or by the use of a smaller amount of starter with a subsequent ripening period, before the addition of the rennet. The cheese from milk set at a lower acidity did not drain properly, were soft and developed off-flavors. Higher setting acidities were found to be detrimental to the texture of the curd; as tough, waxy or gummy textures frequently developed.

Matheson (6) later again recommended that the milk be set at an acidity of 0.21 to 0.23 per cent. Goss, Neilson and Mortensen (7), however, state that the rennet should be added when the milk reaches an acidity of 0.19 to 0.20 per cent. The actual amount of acidity due to added starter and to ripening, which doubtless is of more importance than the acidity of the milk itself, is not mentioned.

EXPERIMENTAL

In the manufacture of Blue cheese at the Dairy Division of the University of Minnesota, considerable variation in the rate of ripening of this cheese has been noted. Along with other factors which might influence the rate of ripening and the uniformity of the cheese, acidity variations during manufacture have been investigated. Variables studied included the amount of starter used, the extent to which the milk was ripened and the acidity of

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[1] The data in this paper are from a thesis presented by J. Spencer George in partial fulfillment of the requirements for the degree of M.S., University of Minnesota. Journal Series Paper 1548, Minnesota Agricultural Experiment Station.

the whey at dipping. The starter used was a culture of *Streptococcus lactis* with associated types.

In each of 5 replicated series, 4800 pounds of raw milk were used. The milk was divided into six lots. Three lots in each series were set at approximately the acidity to which the addition of 4 per cent starter would bring the milk. The other 3 lots were permitted to ripen, following the addition of starter, to an acidity about 0.03 to 0.04 per cent higher. The initial acidity of the milk in the different series varied from 0.15 to 0.20 per cent, causing an equivalent variation in the acidity at which the milk in the comparable lots in the different series was set. In most cases the milk in the low acidity group was set at 0.19 to 0.20 per cent and the high setting group at 0.23 to 0.24 per cent acidity. In each group of 3 vats, one vat was inoculated with 2 per cent starter, one with 3 per cent and the other with 4 per cent starter. Each vat was divided with respect to dipping acidity, half the vat being dipped soon after cutting, while the remainder was left in the whey until the acidity had increased 0.05 to 0.06 per cent. This required about one hour in most cases.

Every effort was made to standardize the composition of the cheese, particularly the salt content. The cheese were salted by rubbing salt over their surfaces. In three applications a total of 7.5 pounds of salt per 100 pounds of green cheese was used. This procedure has been found at this station to produce uniformly cheese containing about 5.5 per cent of salt at 3 months of age.

In addition to the customary manufacturing data, pH determinations were made at the various stages during manufacture and ripening. To follow the cheese ripening, analyses were made for volatile fatty acids and amino nitrogen on the 2-day-old cheese and on the cheese at 3, 6 and 9 months. The cheese were examined for flavor, body, texture, and character of mold growth at 3 month intervals. The cheese also were analyzed for moisture, salt and fat. The pH determinations were made using a quinhydrone electrode with a Leeds and Northrop type K potentiometer. The method described by Currie (8) for the estimation of volatile acids was followed. Results are expressed as millimeters of N/10 acid per 100 grams of cheese. The amino nitrogen values were determined using the micro-Van Slyke gasometric method. Results are expressed as milligrams of nitrogen per gram of dried fat free cheese. One half cheese was ground and used for analysis at each period. Since the cheese are handled separately, individuality of the cheese assumes a considerable role in the variability of the data.

RESULTS

Only one important difference was observed in the cheese during the manufacturing period. The customary procedure is to remove the cheese

from the hoop after about 20 hours. In the first series the cheese made from the milk to which 2 per cent starter was added and set at low acidity were so soft that they flattened somewhat on removal from the hoop. This flattening has been observed in other cheese set at low acidity, particularly in instances in which an inactive starter was used. These results indicate that 2 per cent starter is about the minimum which should be used unless the milk is to be ripened considerably.

The amount of starter used does not appear to have significantly influenced any character of the cheese. This is in keeping with the results secured by Thom and Matheson (5) who found that it was immaterial whether the desired acidity was secured by the addition of starter alone or in part by ripening the milk subsequent to the addition of a smaller amount of starter.

TABLE 1

Influence of variation in setting and dipping acidity on the pH of the cheese at various intervals during ripening

Acidity during mfg. of cheese	Average pH of cheese at different stages of ripening			
	salting	3 months	6 months	9 months
Low setting ..... } Low dipping ..... {	4.76	6.24	5.98	5.82
Low setting ..... } High dipping ..... {	4.72	6.00	5.89	5.71
High setting ..... } Low dipping ..... {	4.79	6.04	5.92	5.63
High setting ..... } High dipping ..... {	4.74	5.98	5.86	5.60

Hydrogen Ion Concentration of Cheese

The acidity of the cheese as indicated by the hydrogen ion concentration appears to have been influenced at certain stages in the ripening of the cheese both by the acidity of the milk at setting and by the acidity of the whey at dipping. These results are summarized in Table 1. Examination of the data by analysis of variance shows that at salting there were no significant differences in the pH values of the cheese in the different acidity groups. At 3 and 6 months the average pH value for the cheese set and dipped at low acidity is somewhat greater than for the other cheese. Those cheese set and dipped at high acidity have the lowest average pH value. There differences are not statistically significant as the ratio of the greater to the lesser mean square is 3.5 at 3 months and 2.2 at 6 months. According to Snedecor (9) unless the value of F (ratio of the greater to the lesser mean square) for this number of observations is equal to or greater than 4.20 there are more than five chances in a hundred that there is no real difference in the data.

By the time the cheese were 9 months of age, however, variations in the setting acidity and in the dipping acidity appear to have caused significant

differences in the acidity of the cheese. The cheese set and dipped at low acidity have the highest and those set and dipped at high acidity the lowest average pH values. The ratio of the greater to the lesser mean square is 22.2 which is far outside of the range of Snedecor's highly significant value, which for this number of observations is 7.64. This indicates that there is much less than one chance in a hundred that there is no real difference in the data.

With high setting acidity, variation in the dipping acidity did not significantly influence the pH of the cheese at 9 months. The difference in the average pH values for the cheese dipped at high and low acidities in the low setting acidity group, however, is highly significant. Setting acidity appears to have affected the pH values of the cheese at this period irrespective of whether the dipping acidity was high or low. The difference, however, is slightly greater for the low dipping acidity group.

The Rate of Ripening

A summary of the data on fat hydrolysis and protein degradation is shown in Figure 1. The values shown are the means for the 60 cheese at each period of analysis. The increase in the volatile fatty acids and amino nitrogen with time is apparently essentially a straight-line relationship.

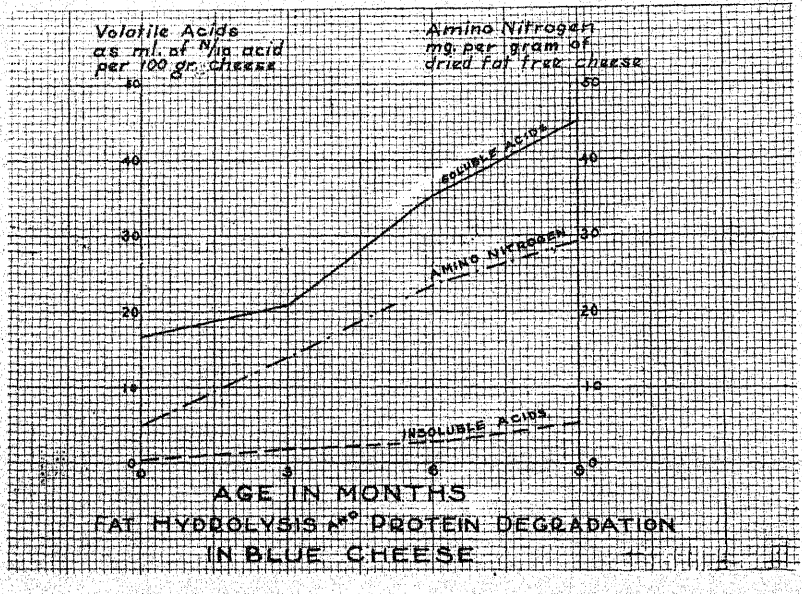

FIG. 1.

The mean values for soluble and insoluble volatile acids and amino nitrogen grouped according to setting and dipping acidity are shown in Table 2.

A low dipping acidity especially when combined with low setting acidity appears to favor fat hydrolysis and protein degradation. The differences between the values for those cheese for which the curd was dipped at low acidity and those dipped at high acidity in the low setting acidity group are significant or highly significant as shown by the values for F, except for the amino nitrogen values at 6 and 9 months and the soluble volatile acids at 3 months. The same trend is apparent at these periods, although the values of F are not sufficiently great to indicate a significant difference.

The mean values for volatile acids and amino nitrogen for the cheese dipped at low acidity are also higher than those for the cheese dipped at high acidity in the high setting acidity group. The F values indicate, however, that there are somewhat more than five chances in a hundred that these differences are due to chance.

For those cheese for which the dipping acidity was high, whether the milk was set at low or at high acidity, there appears to have been no effect on the rate of ripening. The mean values for volatile acids and amino nitrogen are similar at every period. A faster rate of ripening appears to have occurred in those cheese set at low acidity than in those set at high acidity when the dipping acidity was low. These differences are not large, nor very uniform, but do indicate a trend.

Relation of pH to Rate of Ripening

Considering the data as a whole there does not appear to be any consistent difference in the amount of soluble and insoluble volatile acids and amino nitrogen at the various periods attributable to differences in the hydrogen ion concentration of the cheese. As noted previously only at 9 months was there any significant difference in the pH of the cheese in the various acidity groups. At this period the mean pH of the cheese set and dipped at low acidity was very significantly higher than the mean pH of those set and dipped at high acidity. At this period also, the volatile soluble acids and amino nitrogen values for the group set and dipped at low acidity were very significantly higher. The mean value for volatile insoluble acids was higher but not significantly so. The correlation coefficient between the pH and amino nitrogen values for the cheese in these groups at this period is $+0.82 \pm .06$, between pH and volatile soluble acids $+0.69 \pm .096$, and between pH and volatile insoluble acids $+0.29 \pm .17$. Thus there seems to be a definite association between pH and amino nitrogen and pH and volatile soluble acids in the cheese at 9 months. Whether the volatile acidity and amino nitrogen are low because ripening was retarded by low pH, or whether pH is high because of changes in pH due to decomposition products, it is impossible to say.

TABLE 2

The influence of high and low dipping acidity and high and low setting acidity on fat hydrolysis and protein degradation of Blue cheese

Acidity at Dipping	Volatile Acids						Amino Nitrogen		
	Soluble			Insoluble					
	3 mo.	6 mo.	9 mo.	3 mo.	6 mo.	9 mo.	3 mo.	6 mo.	9 mo.
	ml.	*ml.*	*ml.*	*ml.*	*ml.*	*ml.*	*mg.*	*mg.*	*mg.*
Low Setting Acidity									
Low	21.87	41.43	57.29	2.25	3.39	6.03	15.65	24.60	30.85
High	17.60	32.21	39.31	1.60	2.63	4.61	13.86	23.53	29.24
Value of F.*	3.30	10.51	11.30	4.17	7.24	8.52	6.34	1.68	2.27
High Setting Acidity									
Low	23.37	36.48	44.52	2.13	3.17	5.20	14.05	23.64	28.46
High	21.27	32.33	39.24	2.01	2.68	4.96	12.20	22.50	27.64
Value of F.*	1.20	2.59	1.98	0.22	2.07	0.12	4.09	1.28	0.67

* For this number of observations (30) a value of F. as great as 4.20 indicates a significant difference, a value as great as 7.64 a highly significant difference [Snedecor (9)].

Quality of Cheese

Variation in acidity during manufacture did not significantly influence the grade of the cheese but did influence to some extent the occurrence of certain flavors in the cheese. In general high acidities during manufacture resulted in more acidy flavored but less musty flavored cheese. Firm bodied and crumbly cheese occurred more frequently where high acidities were used. The cheese set and dipped at low acidities were ready for market somewhat sooner than those set or dipped at high acidity. This would be expected considering the effect of low dipping and low setting acidity on the rate of fat hydrolysis and protein degradation. These cheese, however, deteriorated in flavor sooner. The cheese in the manufacture of which high acidities were used ripened later, but many of these were sold as excellent cheese when over one year old.

SUMMARY AND CONCLUSIONS

Blue cheese were manufactured using 2, 3 and 4 per cent starter, with the milk set at low acidity (0.19 to 0.20 per cent), and after ripening to 0.23 to 0.24 per cent, with the curd dipped after cutting before additional acidity development, and with dipping delayed until 0.05 to 0.06 per cent acidity developed in the whey.

Variations to this extent in acidity during manufacture do not appear to be highly important in the manufacture of Blue cheese. Excellent cheese were produced with all combinations used. Cheese set and dipped at low acidity as indicated by fat hydrolysis, protein degradation and character of the cheese, ripened somewhat sooner than those set and dipped at high acidity.

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American Dairy Science Association Announcements

AMERICAN DAIRY SCIENCE ASSOCIATION ANNUAL MEETING JUNE 14–17, COLUMBUS AND WOOSTER, OHIO

HOUSING PLANS

The University girls' dormitories located on the campus will be available beginning June 14 for approximately 350 people at a cost of $1.00 per person per night. The rate for children will be the same as for adults. Many of the rooms have connecting baths and all facilities are good. The dormitories are within one block of the place of meetings. Rooms will also be available at special rates in Columbus hotels. Members will receive full details regarding housing in a letter to be sent out in early May. All reservations and further information on housing can be obtained from the chairman of the Housing and Registration Committee, J. H. Erb, Dept. of Dairy Technology, Ohio State University, Columbus, Ohio.

GOLF AT THE CONVENTION

It is hoped that those in attendance at the Annual Meeting will take advantage of the excellent golf facilities at the University. The University is opening a new course this spring which will be available at a nominal cost.

Make your plans now to bring your family and attend the annual meeting.

JOURNAL CIRCULATION

The officers of your Association are attempting to increase the circulation of the JOURNAL OF DAIRY SCIENCE to 2000.

In 1936 the officers made an agreement with the International Association of Milk Dealers and the International Association of Ice Cream Manufacturers to publish abstracts of literature on milk and milk products. The two Associations agreed to promote the circulation of the JOURNAL. The circulation was increased a little more than 400. It reached about 1785 in 1936.

In 1937 there were 958 members, 745 subscribers and 111 associate subscribers making a total circulation of 1813.

Each year we have about 300 who drop their membership or subscriptions. In order to get our circulation to 2000, it will be necessary to increase the membership and subscribers by about 500.

By the fifteenth of March, 790 of the 1937 members had paid their dues, 539 of the subscribers had renewed, and 70 of the associate subscribers had renewed for 1938. Many of the delinquent members and subscribers will, we trust, pay up in 1938. We now have 107 new members, 82 new subscribers, and 49 new associate subscribers, making a total circulation of 1637.

We will appreciate your requesting subscription order blanks or application blanks to send to prospective members and subscribers.

We should have more commercial breeders and those interested in dairy production as our readers. It will be necessary to increase our circulation to carry the additional cost of production abstracts.

We are sorry to announce the passing of Prof. Rush B. Locke on January 27, 1938. Professor Locke had charge of the work in dairy manufacturing at the Colorado State College, Fort Collins, Colo. He had been ill for the past six months.

Prof. Rush B. Locke was born April 22, 1898. He attended South Dakota State College from which he received the bachelor of science degree in June, 1924. In 1925 and 1926 he occupied a teaching fellowship at Iowa State College from which institution he received the degree of master of science in 1926. From 1926 until 1928 he was an instructor in the Department of Dairy Manufactures at Iowa State College. In 1928 he came to the Colorado State College as associate professor of dairy manufactures.

In August, 1937, he went to Fitzsimmons General Hospital (U. S. Army), Denver, Colorado, for observation. He remained there almost continuously, with the exception of a few happy week-ends at home, until his death January 26, 1938, when he died of nephritis and heart disease. Surviving him are Mrs. Locke and their three sons, Rush, Jr., 11 years of age, Richard, 9, and David, 7. Locke was much admired and respected by his friends on our campus and had played an especially important role by establishing and managing a dairy short course of several days duration each year.

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ABSTRACTS OF LITERATURE

A. C. DAHLBERG, Editor
Geneva, New York

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SPECIAL PUBLICATIONS

Federal Dairying and Bacteriological Establishment, Liebefeld, Berne, Switzerland
International Association of Ice Cream Manufacturers
International Association of Milk Dealers
National Institute for Research in Dairying, Reading, England
New York Association of Dairy and Milk Inspectors
Prussian Dairy Research Institute, Kiel, Germany
State Agricultural Colleges and Experiment Stations
The Royal Technical College, Copenhagen, Denmark
United States Department of Agriculture

ABSTRACTS OF LITERATURE

BACTERIOLOGY

123. Standardization of Tablets for Determining Methylene Blue Reduction in Milk. H. J. CONN, N. Y. Agr. Exp. Sta., Geneva, N. Y. Am. J. Pub. Health *27*, 8, p. 793, 1937.

The variation in the dye content of Danish and American tablets is discussed. Methylene blue thiocyanate is preferable to methylene blue chloride. Methylene blue thiocyanate tablets are now being placed upon the market with the approval of the Committee on Standard Methods of Milk Analysis of the American Public Health Association. It is believed that American manufacturers will be able to put out a very uniform product.

M.W.Y.

124. Influence of Contaminating Bacteria on the Results of the Microscopic Test for Streptococci Mastitis. C. S. BRYAN AND E. A. NELSON, Michigan Agr. Exp. Sta., East Lansing, Michigan. Am. J. Pub. Health *27*, 9, p. 914, 1937.

Placing 0.1 cc. of a sterile 1–500 aqueous dilution of brilliant green into each tube prior to collecting a 10 cc. sample from the udder is recommended as a method of inhibiting contaminants. M.W.Y.

125. Influence of Dead Bacteria on Microscopic Counts of Pasteurized Milk. ARCHIBALD R. WARD AND CHARLES E. MYERS, Dairy Testing Lab., Detroit, Michigan. Am. J. Pub. Health *27*, 9, p. 899, 1937.

The widely held belief that bacteria killed by pasteurization remain visible and are counted together with those remaining alive is not accepted by the author. Microscopic counts were made from milk held for varying lengths of time at 142° to 144° F. The author concludes that insufficient numbers of dead bacteria remain visible after pasteurization to impair the usefulness of direct microscopic counts made on pasteurized milk.

M.W.Y.

126. Modified Methylene Blue Reduction Technic. H. R. THORNTON, Univ. of Alberta, Alberta, Canada. Am. J. Pub. Health *27*, 8, p. 791, 1937.

Advantages and disadvantages of shaking the tubes of milk during incubation, the standard technic in Great Britain, are discussed. A comparison of the standard and modified tests on 332 market milks showed that neither test greatly excelled the other in accuracy, despite the greater variability

of the standard test. The author finds no justifications for adopting the modified test as standard on this continent. M.W.Y.

127. The Need of Uniformity of Conditions for Counting Plates with a Suggestion for a Standard Colony Counter. JACQUES ARCHAMBAULT, J. CUROT, AND MAC H. MCCRADY, Div. of Lab., Quebec Ministry of Health, Montreal, Quebec. Amer. J. Pub. Health *27*, 8, p. 809, 1937.

A counter for enumerating bacterial colonies on agar plates prepared from milk, water and other materials is described. The "Quebec Colony Counter" combines the essential features which makes for constant magnification and illumination, for the convenience and comfort of the operator, and for accuracy of counts. M.W.Y.

128. The Method of Frost Modified by Van Oijen. H. BARKWORTH, Special Dairy Bact., College of Agr. of the Southeast, Wye, Kent. Le Lait *17*, 168, p. 810, Sept.–Oct., 1937.

The modified method of Van Oijen was compared with the standard plate count procedure for determining the bacterial count of milk. The Van Oijen slides were incubated at 28° C. (82.4° F.) for 24 hours. The Van Oijen procedure was considered more precise than the plate count procedure for determining the bacterial count of milk. Details of the Van Oijen procedure are given. A.H.J.

129. The Colon Bacilli Sensitive to Bacteriophage. IRENE LIPSKA, Municipal Inst. of Hygiene, Warsaw, Poland. Le Lait *17*, 169, p. 913, Nov., 1937.

Of the sensitive colon bacilli studied, 68.6 per cent of the strains had chemical properties characterizing them as fecal strains. Following the classification, *Bact. coli commune* had 31.4 per cent of sensitive strains. The greatest frequency of sensitive strains (100 per cent) was among the birds and the marine invertebrates. The vigor of development at 22° C. (71.6° F.) and at 37° C. (98.6° F.) as well as the vitality of the strain as shown by the rate at which carbohydrates are fermented are inverse to the sensitivity of attack by bacteriophages. The sensitive strains of colon bacilli studied are characterized by a great constancy in their properties comprising more or less high resistance to bacteriophage. A.H.J.

BUTTER

130. Differences in the Lactic Acid Percentages in Butters. E. O. WHITTIER AND C. S. TRIMBLE, Bureau of Dairy Industry, Washington, D. C. Am. Creamery and Poultry Prod. Rev. *81*, 15, p. 518, Feb. 12, 1937.

Butter made from cream containing less than 0.25 acid and no starter will contain less than 0.025 apparent lactic acid; cream with 0.4 or greater per cent acid and no neutralizer will produce butter with 0.1 or greater per cent acid; sour cream neutralized to 0.2 per cent acid will contain 0.15 or more acid; cream treated with water or sweet skimmilk or washed with alkaline water will show slightly decreased acid content; and storage of butter at somewhat higher temperatures than those usually used will show no increase in apparent acid content. P.S.L.

131. Progress in the Cream Improvement Movement. J. O. CLARKE, Food and Drug Administration. Am. Creamery and Poultry Prod. Rev. *83*, 15, p. 504, Feb. 10, 1937.

In 1935, 1936, and 1937 the per cents of cans of cream condemned were 4.00, 3.06, and 2.88 respectively. The program of improvement has just begun; better tests for measuring fitness of cream are needed. The sediment test does not measure decomposition; taste and odor standards are indefinite. Acidity, hydrogen-ion concentration and formol tests, and mold counts are being used to a greater degree. The first is used indirectly as an index of conditions of sanitation. The second may be impractical for creamery use since neutralizer nullifies the results. This is not true for the formol test. It is of value in judging relative degree of decomposition. A special test has been perfected for relative mold contamination and has given good results. Farm sanitation and frequent delivery of cream are objectives in any good cream improvement program. P.S.L.

132. Laboratory Manual of Methods of Analysis for the Butter Industry, by the Research Committee (M. E. PARKER, *chairman*) of the American Butter Institute, 110 North Franklin St., Chicago, Ill.

This manual was designed to give the practical analytical procedures which may be used in a good creamery laboratory and which are used in the laboratory of the American Butter Institute. The official control methods are not included, for they are generally not adaptable to plant work.

The various chapters presented are on butter sampling; determination of yeasts and molds, moisture, fat, salt, and curd; pH; diacetyl and acetylmethylcarbinol; sediment testing of milk, cream, and butter; titratable acidity; the Babcock test; keeping quality of butter; and checking acidity and salt test solutions.

The manual has been printed only on one side of the paper and it opens flat on the dest. The style is such as to be of greatest use in the creamery laboratory. A.C.D.

133. Delaying Oxidative Changes in Butter. C. D. DAHLE AND D. V. JOSEPHSON, Dairy Dept., Penn. State College, State College, Pa. Nat. Butter and Cheese J. *28*, 18, p. 18, Sept. 25, 1937.

A water extract of oat flour (Avenex No. 7) added to sweet or sour cream before pasteurization improved the keeping quality of the butter without imparting off flavor or incorporating sediment. The weight of Avenex used equaled 1 per cent of the fat. This amount seemed to give ample protection against oxidative deterioration of butter during storage for two months at 40 to 45° F. W.V.P.

134. **Butter Color and Vitamin A.** K. G. WECKEL, Univ. of Wisconsin, Madison, Wisconsin. Nat. Butter and Cheese J. *28*, 17, p. 28, Sept. 10, 1937.

Natural yellow color of butter is due chiefly to carotene which in the animal body is transformed to vitamin A. A graph shows seasonal variations in carotene, vitamin A, and vitamin A activity in butter. Carotene accounts for 15 per cent of total vitamin A activity. There is little difference in total vitamin A activity of fat from four common breeds of cows when on the same ration, although carotene values vary widely. Feeds rich in carotene are listed and butter manufacturers are urged to encourage their use in order to improve nutritive value of butter. W.V.P.

135. **Stabilization of Butter Against Oxidized Flavor.** VIRGIL L. KOENIG, Okla. Agr. Exp. Sta., Stillwater, Oklahoma. Nat. Butter and Cheese J. *28*, 15, p. 26, Aug. 10, 1937.

Butter prints wrapped in parchment paper which had been treated with oat flour (Avenized Parchment) and butter mixed with 0.06 per cent of a hexane extract of oat flour (Avenol) and then wrapped in ordinary parchment were stored at 0° F. and at 50° F. for seventeen weeks. Avenized parchment and Avenol showed definite protective action against tallowiness and rancidity development. Avenol gave an off flavor to the butter during the first four weeks of storage. W.V.P.

136. **Improving the Keeping Quality of Butter with Treated Parchment.** C. D. DAHLE AND D. V. JOSEPHSON, Dairy Dept., Penn. State College, State College, Pa. Nat. Butter and Cheese J. *28*, p. 6, July 25, 1937.

Prints of butter wrapped in Avenex-treated parchment kept better at 45° F. and and slightly better at −15° F. than butter wrapped in ordinary parchment. W.V.P.

137. **Keeping Down the Yeast and Mold Counts.** A. E. GROTH, Federal-State Butter Grader, Mankato, Minn. Am. Creamery and Poultry Prod. Rev. *83*, 18, p. 702, March 10, 1937.

Mold spores may be kept down by keeping the creamery dry as with the use of overhead heating unit systems together with proper ventilation; by

frequent cleansing of the buttermilk and water storage tanks; keeping the covers of vats closed during pasteurization so as to pasteurize foam; drawing cream from gates of vats when heated and pouring into main body of cream; elimination of "dead pockets" in vats; checking seams and stuffing boxes frequently for contamination; thorough cleansing of pipe lines and pumps; especially thorough cleansing of the churn, for this is one of the chief sources of mold. Directions are given for care of the churn. P.S.L.

138. Carotene in Butter Coloring. R. B. STOLTZ AND T. S. SUTTON, Ohio State University, Columbus, Ohio. Am. Creamery and Poultry Prod. Rev. *84*, 20, p. 614, Sept. 8, 1937.

The study concerns the use of semi-purified carotene in oil as a coloring material for winter butter, and as a method of increasing vitamin A content. Fifteen drops of Smaco carotene oil was added to a pound of butter and this was checked against a like sample containing no added carotene. Rats fed on the first sample showed a superior growth. Using a second group of rats, ¾ pound of butter colored with another brand of carotene produced as much growth as a group fed untreated winter butter. It was found impractical to raise the vitamin A content of winter butter, however, to that of June butter. In the latter case, using Primatone, it was necessary to use four ounces per 100 pounds butterfat to get a desired color. P.S.L.

Other Abstracts of interest are numbers 148, 182, 201, 207, 208, 209, 215, 216, 217, 218, and 219.

CHEESE

139. Modifications in the Composition of Cheese in the Course of Prolonged Storage. JEAN PIEN AND G. MAURICE, Lab. of the Farmers' Union, Paris, France. Le Lait *17*, 170, p. 1040, Dec., 1937.

The moisture content of Camembert cheese diminished regularly from 53 to 15 per cent during 13 months storage. During this period a considerable loss in dry matter also took place as a result of fermentation. This loss can attain 15 per cent of the original dry matter in the cheese and can accordingly cause a considerable increase in percentage of fatty matter in the moisture-free cheese, as the fatty matter is not lost by fermentation. During storage of the cheese for 13 months, the soluble nitrogen attained a value of 41.5 per cent of the total nitrogen and ammonia nitrogen was 60 per cent of the soluble nitrogen. During the storage period the total nitrogen of the cheese decreased from 6.36 per cent to 5.58 per cent, the soluble nitrogen increased from 0.55 per cent to 2.20 per cent and the ammonia content from 0.17 per cent to 1.25 per cent. A considerable percentage of ammonia nitrogen is lost from the cheese at the same time that other volatile matter results from the processes of fermentation. The losses that have been

described occurred when the cheeses were stored at a temperature of 8 to 10° C. (46.4° to 50° F.). A.H.J.

140. On the Change of the Lactose Content of the Curd after the Addition of Water in Making Edam Cheese. H. A. SIRKS, Report of the Experimental Dairy Farm, Hoorn, Holland, pp. 159–174, 1937 (English summary).

The cheesemaker often adds water to the whey during the cheesemaking process to lower the lactose content of the curd. In this study it was found that at least 15 minutes must be allowed after the addition of the water before the whey is drained off the curd, to make certain that a lactose equilibrium has been reached between that in the curd and the whey. A.C.D.

141. The Influence of Salt on the Composition and Quality of Brick Cheese. E. L. BYERS AND W. V. PRICE, Univ. of Wisconsin, Madison, Wisconsin. Nat. Butter and Cheese J. *28*, 14, p. 10, July 25, 1937.

A salt content of approximately 2 per cent by weight of the cheese seemed best. Less salt encouraged abnormal fermentation, high moisture, weak body and open texture. Excessive salting caused hard, harsh body, unnaturally white color, low moisture, loss of yield, delayed lactose fermentation and slow ripening. W.V.P.

142. Identification of Roquefort Cheese. IRA D. GARARD, ABRAHAM MINSKY, JAMES H. BAKER, AND VIOLA PASCALE, New Jersey College for Women, Rutgers Univ., New Brunswick, N. J., and Gar-Baker Lab., Inc., New York, N. Y. Ind. and Eng. Chem. *29*, p. 1167, Oct., 1937.

The fraudulent substitution of cow's milk Blue cheese for the more expensive ewe's milk Roquefort cheese makes desirable an effective means of differentiation. The color of the fat and its Polenske value provide a reliable method. Analyses of the fat of numerous authentic Roquefort cheeses and of a wide variety of cow's milk cheeses are reported. Polenske values for sheep milk fat varied between 3.6 and 5.95, while those for cow's milk fat never exceeded 2.9. The color of the extracted fat from cow's milk cheese was always deep yellow; that from ewe's milk fat was always pale green. The diet of the animals was found not to be responsible for the difference in range of Polenske values. The Polenske number does not change with the age of Roquefort cheese. J.H.N.

143. The Fermentation of the Egyptian Cheese "Mich." EL GHERIANY MOSTAFA, Bact. of the Dairy Service in the Lab. of Vet. Path., Guizeh, Egypt. Le Lait *17*, 168, p. 819, Sept.–Oct., 1937.

Bacillus saccharobutyricus amylobacter and *Streptococcus faecium* were regularly identified in "Mich." Often but not regularly "Mich" also contained *Bacillus mesentericus, Bacillus subtilis, Proteus ichthyosmus* and *Flavobacterium butyri.* On aging from 5 months to 14 months, the pH increased from 4.96 to 5.41, and the volatile acidity from 46 to 80 degrees Soxhlet. During the same period the butyric acid increased from 1.01 to 1.76 grams per 100 grams of the cheese. A.H.J.

Other Abstracts of interest are numbers 123, 126, 182, 207, 208, 209, 215, 216, 217, 218, and 219.

CHEMISTRY

144. The Physical and Chemical Properties of Casein Fat. SAMUEL G. STEVENSON AND ALFRED L. BACHARCH, Glaxo Lab., Ltd., Greenford, Middlesex, England. Biochem. J. *31*, 721, 1937.

It was reported in 1924 by other investigators that an anhydride of a hydroxystearic acid was obtained by repeated extraction of the residual fat occluded with casein separated from skimmilk.

The present authors investigated further the character of the fat extracted from lactic acid casein subsequently employed in preparing "fat-free caseinogen" used in Vitamin A-free basal diets. A comparison of the fat constants of the extracted fat with those for normal butterfat indicates that the casein fat is for the greater part indistinguishable from butterfat. A threefold concentration of unsaponifiable matter in the casein following purely mechanical separation of most of the milk fat is of interest and may be of physiological significance. An absence of phosphorus and consequently phospholipins in the extract was noted. K.G.W.

145. Metallic Content of Foods an Important Health Matter. A. H. STAND, Consulting Chemist, New York City. Cert. Milk *11*, 120, p. 7, April, 1936.

This article describes briefly spectrographic analysis as a new technique for a rapid qualitative and quantitative determination of metals in dairy products. By this method of analysis the author demonstrates the presence of tin in evaporated milk and the dissolving effect of cheese on tin foil. W.S.M.

146. The Value of the Volumetric Formol Procedure for Determining the Protein Content of Milk. B. VAN DER BURG AND L. HABERS, Dairy Lab. of the Agr. Univ., Wageningue, Holland. Le Lait *17*, 168, p. 805, Sept.–Oct., 1937.

The determination of the protein content of milk by the formol titration procedure was not found to have the required accuracy. A.H.J.

147. **The Determination of Carotene in Forage.** G. GENIN, Chemical Eng., Paris, France. Le Lait, *17*, 169, p. 727, Nov., 1937.

The author discusses the modifications introduced by Peterson, Hughes and Freeman into Guilbert's method for determining carotene. A.H.J.

148. **The Determination of pH in the Service of Milk and Dairy Products Industry.** ALFRED KARSTEN. Le Lait *17*, 169, p. 918, Nov., 1937.

Recently developed colorimetric and electrometric methods of determining the hydrogen ion concentration of dairy products are discussed. Photographs of the electrometric apparatus are shown. The significance of pH value in various branches of the dairy industry is discussed. Thus fresh milk outside the normal pH range 6.4 to 6.6 may indicate that it came from diseased cows. The use of pH control in the selection of milk for evaporated milk, milk powder as well as in the manufacture of butter and casein is discussed.

A.H.J.

149. **Measuring Milk Film.** H. H. BECK, K. G. WECKEL, AND H. C. JACKSON, Univ. of Wis., Madison, Wisconsin. Am. Creamery and Poultry Prod. Rev. *83*, 13, p. 444, Jan. 27, 1937.

Thickness of the film of milk passing over irradiation apparatus and its speed of travel are factors in the determination of the degree to which it is subjected to ultra violet light, and should be of value to designers of apparatus for irradiation. Thickness of milk film was measured by light. A narrow beam of light was thrown at an angle of incidence of 45° on the metal surface and the reflected beam measured. The reflected beam was again measured while a film of milk was run over the surface. The distance between the two parallel beams of reflected light was determined and from this the thickness of the film calculated by geometrical formula.

P.S.L.

150. **The Composition of Rabbit Milk Stimulated by the Lactogenic Hormone.** A. J. BERGMAN AND C. W. TURNER, Univ. of Missouri, Columbia, Mo. J. Biol. Chem. *120*, 21, 1937.

The composition of rabbit milk obtained at various intervals after normal parturition was compared with the milk obtained from pseudo-pregnant rabbits in which lactation had been induced experimentally by the injection of lactogenic hormone for six days.

The amount of lactose and total solids in the experimental milk obtained from a rabbit having a 4+ rating (Gardner and Turner, in which the gland contains 0.76 to 1.0 per cent of lactose) were similar to that in the normal milk. The amount of fat was higher, and the ash content lower, in the experimental milk.

K.G.W.

CONCENTRATED AND DRY MILK; BY-PRODUCTS

151. Observations on Concentrated Frozen Milk. F. J. DOAN AND C. E. FEATHERMAN, Division of Dairy Mfgrs., Penn. State College, State College, Pa. Milk Dealer *27*, 2, p. 33, 62, Nov., 1937.

A report of studies on the concentration and freezing of milk as a means of preserving the product for a period of several weeks. The following factors were studied: (a) Degree of concentration, (b) homogenization, (c) length of holding period, (d) temperature of thawing.

The authors concluded that:

In concentrating and freezing milk for storage purposes a degree of concentration of approximately 3 to 1 appears to give most satisfactory results.

Homogenization prevents a rise of cream in the thawed, reconstituted milk. It decreases the tendency to churn, oiling-off and form cream plugs and also appears to aid in preventing tallowy flavor.

The length of time milk concentrated 3 to 1 can be held in a frozen condition and still produce a normal reconstituted product is somewhat indefinite and probably varies with the qualities of the original milk, the equipment used and the method of handling. From these results a storage period of 12 weeks seems quite possible.

The protein of concentrated frozen milk is apparently denatured by holding for long periods in the frozen state. This, however, appears to be a reversible action. In one sample encountered in these studies, protein which was apparently badly coagulated was re-dispersed in normal fashion by heating to temperatures between 150 and 160° F.

The thawing temperature does not exercise much influence on the properties of the reconstituted, concentrated frozen milk but a temperature of 120° F. appears to give less trouble in thawing and reconstituting than room temperatures of 50° F.

The number of trials made in this study and the number of samples included are too few to warrant very positive conclusions and it is hoped that the study may be continued in more detail, particularly with respect to the type of protein coagulation obtained when concentrated milk is held in the frozen state and with respect to the effect of concentration and freezing upon the curd tension. C.J.B.

152. Chemists Produce "Wool" from Milk. Home Economics Dept., Ohio Agr. Exp. Sta., Columbus, Ohio. Ohio Agr. Exp. Sta. Weekly Press Bull. No. 22, 44, Jan. 6, 1938.

A brief description of the Italian process is given and a prediction made that "wool" from milk may develop comparably to rayon. W.E.K.

153. The Concentration and Properties of Vitamin H. LELA H. BOOKER, Dept. of Chemistry, Columbia University, New York. J. Biol. Chem. *119*, 223, 1937.

Methods for separating the relatively heat stable Vitamin H of the Vitamin B complex from low lactose whey powder, and from rice polishings is described. By the methods there is obtained 30 fold and 60 to 90 fold increase in concentration of the factor present in the whey powder and rice polishings, respectively. K.G.W.

154. Casein in the Fabrication of Plastic Materials. G. GENIN, Paris, France. Le Lait *17*, 168, p. 815, Sept.–Oct., 1937.

Casein precipitated by rennin is required for the making of casein plastics. A review is given of the methods for making casein plastics. Uses of casein plastics are discussed. A.H.J.

155. The Fabrication of Artificial Wool. G. GENIN, Chemical Engineer, Paris, France. Le Lait *17*, 169, p. 949, Nov., 1937.

A general discussion is given of the manufacture of casein and the fabrication of artificial wool fibers (Lanital) therefrom. Comparative carbon, hydrogen, oxygen, nitrogen and sulphur contents of true wool and Lanital are given. Except for the sulphur content which is higher in wool and the carbon content which is higher in Lanital, the composition of the two substances is much the same. In cold caustic soda Lanital dissolves more rapidly than wool. On burning wool and Lanital fibers, the residues are much the same. On boiling a sample of Lanital for 3 hours in an alkaline soap solution, it loses about 1 per cent of its weight, while on treating wool in the same manner, the loss in weight is about 10 times as great. Lanital is readily dyed. It is felted more readily than wool. A.H.J.

Other abstracts of interest are numbers 123, 124, 125, 126, 127, 132, 133, 134, 135, 136, 144, 145, 148, 149, 150, 157, 158, 159, 164, 165, 175, 176, 182, 188, 197, 199, 201, 202, 206, 207, 208, 209, 211, 212, 215, 216, 217, 218, and 219.

DISEASES

156. Bovine Tuberculosis. Editorial. Am. J. Pub. Health, *27*, 9, p. 919, 1937.

This editorial describes an outbreak of tuberculosis in a Swedish rural community in which 50 persons, mostly children, suddenly showed signs of tuberculosis. Practically all had been supplied with raw milk from one dairy. One cow which had been passed as free from tuberculosis upon clinical examination by veterinarians had an acute tuberculosis of the udder which resembled the usual type due to streptococcus. However, the milk

teemed with tubercle bacilli. Clinical examination of milk cows, even by the most skillful veterinary surgeon, is not sufficient. "Not only should milch cows have the tuberculin test, but all market milk should be pasteurized, and this applies even to what we know in this country as Certified milk" states the editorial. M.W.Y.

157. A Milk-Borne Epidemic and Its Lesson. Editorial. Am. J. Pub. Health, *27*, 10, p. 1042, 1937.

Only pasteurization of all market milk can avert such tragedies as the outbreak of typhoid fever in England which is described. Approximately 718 persons contracted the disease, 31 cases being fatal. Pasteurization was immediately successful in bringing the outbreak to an end. M.W.Y.

158. Vaccination Against Bang's Disease in an Infected Dairy Herd with United States Bureau of Animal Industry Brucella Abortus Strain 19. C. M. HARING, University of California, Berkeley, Calif. J. Am. Vet. Med. Assn., N.S. *45*-1, p. 52, Jan., 1938.

In a test of the resistance of dairy cattle to Brucella infection, 93 heifers were vaccinated with vaccine prepared from strain 19. During a four year period in which these heifers were in a dairy herd affected with brucellosis, this treatment apparently has been beneficial in retarding the spread of the disease. Strain 19 was not spread to healthy non-vaccinated cattle through association with vaccinated animals. Vaccine from strain 19 used on four cows induced a pronounced but temporary drop in milk production. Vaccination during advanced pregnancy of a cow kept in isolation brought about a typical brucellosis. J.W.W.

159. Consider Vaccines for Bang's Disease. B. H. EDGINGTON, Ohio Agr. Exp. Sta., Animal Disease Control Laboratory, Reynoldsburg, O. Ohio Agr. Exp. Sta., Weekly Press Bull. *22*, 45, Jan. 13, 1938.

Indiscriminate use of vaccines is not justified in any known scheme of Bang's disease control. Calfhood vaccination seems to have merit, although its use is still in the experimental stage. The use of vaccines appears most warranted in infected herds where removal of reactor cattle or adequate segregation of reactor and non-reactor animals is impractical. W.E.K.

FEEDS AND FEEDING

160. Preparation and Nutritive Value of A. I. V. Alfalfa Silage for Dairy Cows. MALCOLM BEESON, College of Agr., Madison, Wis. Cert. Milk *12*, 137, p. 9, Sept., 1937.

The A. I. V. method of making silage is the preservation of green plant tissue by adjusting the pH to 3 or 4 with mineral acids.

The nitrogen distribution of A. I. V. alfalfa silage showed some proteolysis but only slight ammonia production. The carotene content of this silage was equal to that of the original green tissue.

The feeding of A. I. V. alfalfa silage to dairy cows definitely increased the carotene and vitamin A content of the milk. The blood also showed a much higher carotene content. No unusual changes in milk production resulted from feeding A. I. V. alfalfa silage. Rats fed mineralized A. I. V. silage showed a greater average growth than rats fed mineralized winter milk.

Blood and urine analyses indicated that the higher acid intake of the cows was being neutralized by means which prevented any deleterious effects on the animals. W.S.M.

161. Molasses Silage Produces Unusual Results in Feeding. C. B. Bender, New Jersey Agr. Exp. Station, New Brunswick, N. J. Cert. Milk *12*, 136, p. 9, Aug., 1937.

Feeding trials were conducted to study the color and flavor of milk produced by Guernsey cows when fed on various types of roughage. It was found that the color was maintained more uniformly in the groups receiving grass silage as part or all their roughage. The roughage ration which contained a high proportion of good quality molasses silage was superior to corn silage in its ability to produce milk of a high color and flavor. W.M.S.

162. Need Vitamin A for Normal Reproduction. T. S. Sutton, Ohio Agr. Exp. Sta., Wooster, O. Ohio Agr. Exp. Sta. Weekly Press Bull. *22*, 47, Jan. 27, 1938.

Recent experiments having shown that a ration deficient in vitamin A may produce permanent sterility in both males and females, it is recommended that the practice of feeding bulls low quality hay refused by other classes of livestock be discontinued. W.E.K.

163. Making Silage from Hay Crops. A. E. Perkins, C. C. Hayden, C. F. Monroe, W. E. Krauss, and R. G. Washburn, Ohio Agr. Exp. Sta., Wooster, O. Ohio Agr. Exp. Sta. Bimonthly Bull. *23*, 190, pp. 3–12, Jan.–Feb., 1938.

Four methods of making legume silage (molasses, mineral acid, dry ice, and no treatment) are described briefly. Experiments with a special apparatus for exerting pressure on green material demonstrated that dry-matter content of the material to be ensiled is of prime importance. Appreciable loss of juice was obtained when green material containing less than 25 per cent dry matter was subjected to 8 pounds pressure per square inch. This corresponds to the pressure at the bottom of 26 to 28 feet of legume silage containing 30 per cent dry matter. Samples containing 30 per cent dry

matter lost no juice under 8 pounds pressure and little when under 12 pounds pressure. It is recommended that silo filling operations be so planned that the lighter, dried material go into the silo first and be followed with the heavier, wetter material. W.E.K.

FOOD VALUE OF DAIRY PRODUCTS

164. Vitamin D Milk—Its Rôle in the Prevention and Treatment of Rickets. BENJAMIN KRAMER, Pediatric Research Lab., Jewish Hospital, Brooklyn, N. Y. Cert. Milk *11,* 125, p. 3, Sept., 1936.

The author's conclusions in part are as follows:

The best evidence fails to reveal any difference in potency unit for unit between the different forms of vitamin D milk.

When milks containing a larger number of vitamin D units (400 to 430) are compared with those containing 135 units per quart, the former are found to be more effective as measured by rate of growth, calcium and inorganic phosphorus in the serum, calcium and phosphorus retention in the bones, and complete absence of roentgenological and clinical signs of rickets.

In the prevention of rickets in the prematurely born infant and in the treatment of the disease in the more resistant child, vitamin D milk must be supplemented by other antirachitic agents. W.S.M.

165. Scientific Control of the Nutritional Content of Cow's Milk. W. C. RUSSELL, Rutgers Univ., New Brunswick, N. Y. Cert. Milk *12,* 132, p. 5, April, 1937; *12,* 133, p. 5, May, 1937; *12,* 134, p. 10, June, 1937.

This series of articles deals chiefly with a discussion on attempts which have been made to change the composition of milk by variation of the constituents of the ration. Thirty-four references on the more recent reports on this subject are given. The author concludes that generally speaking, the constituents of milk which give to milk its characteristic properties tend to remain constant in concentration, regardless of the composition of the ration. Thus, the milk proteins, fat, lactose, calcium and phosphorus, tend to be maintained at constant values, whereas vitamins A, C, and D, and iodine can be varied to a considerable extent by the level at which these substances occur in the ration. W.S.M.

HERD MANAGEMENT

166. Calf Raising Problems. H. A. HERMAN, Missouri College of Agric. Jersey Bulletin, *57,* 3, Jan. 19, 1938.

The maintenance of the dairy herd in numbers and established production levels requires the replacement of 20 to 30 per cent of the cattle annually. The necessity for this high replacement rate may be largely attributed to

Bang's disease, mastitis, sterility, and low production. Various reported studies show the average cow in the D.H.I.A. of this country remains in the herd from 3.6 to 4.7 years after freshening. The advantages and disadvantages of raising calves are discussed. It is suggested that in general the most satisfactory method of maintaining and improving the herd is by the raising of carefully selected calves. The calf crop should be culled thoroughly and only those from the best cows and sired by well bred sires kept. Calf mortality is exceedingly high in many herds, studies are reported showing that only about 50 to 75 per cent of all the heifers saved come into production. Scours, pneumonia, and general digestive disturbances account for most of the losses. A plan of careful management and strict sanitary measures is suggested as a means of combatting high calf mortality. The care of the newborn calf, and the raising of the calf to maturity by various feeding programs is discussed. The reader is referred to Mo. Agr. Exp. Sta. Bull. 377 for a description of the various methods successfully employed in calf raising. L.C.

167. What Can be Learned from Production Records. C. Y. CANNON, Iowa State College. Jersey Bulletin *57*, 2, Jan. 12, 1938.

The objectives of cow testing programs are outlined and are stated to be: (1) to obtain a check whereby feeding and management improvements can be made on cows so as to increase financial returns, (2) to discover those superior cows whose blood should be used for the production of the next generation, and (3) to test the breeding powers and merit of bulls in service.

As butterfat production increases from 200 to 500 pounds, the increase in feed costs moves at the rate of about $11 to $12 per cwt. of butterfat. The value of the product increases more rapidly so that there is a greater difference between feed costs and value of product.

Records at the Iowa State College dairy farm shows that of every 100 two-year old heifers entering the herd, 77 per cent become three-year olds; 57 per cent become four-year olds; 41 per cent become five-year olds; 31 per cent become six-year olds; 22 per cent become seven-year olds; 14 per cent become eight-year olds; 11 per cent become nine-year olds. These figures vary but slightly from Iowa Cow Testing Association records. Such losses from the herd are caused by various agents. L.C.

168. Water Your Cows Well. C. C. HAYDEN, Ohio Agr. Exp. Sta., Wooster, O. Ohio Agr. Exp. Sta. Weekly Press Bull. *22*, 44, Jan. 6, 1938.

Cows have a requirement for water from 4 to 5 times greater than the amount provided in their milk. Even dry cows need 10 gallons or more daily. W.E.K.

169. **Pasture Improvement Gives Good Returns.** D. R. DODD, Ohio Agr. Exp. Sta., Wooster, O. Ohio Agr. Exp. Sta. Weekly Press Bull. *22,* 47, Jan. 27, 1938.

In a series of tests extending over 7 years, a liberal treatment of 20 per cent superphosphate on limed pasture land produced 244 pounds of beef per acre in comparison with 135 pounds where no phosphate was used. When a high white clover content prevailed the difference was even greater. In terms of milk, the areas without phosphate produced the equivalent of 1078 pounds; all the phosphate areas, an average of 1950 pounds, and the high clover phosphated areas, 2255 pounds. W.E.K.

ICE CREAM

170. **Air Conditioning the Retail Ice Cream Outlet.** ARTHUR BEHRSTOCK, Walgreen Drug Co., Chicago, Ill. Ice Cream Rev. *21,* 1, p. 22, Sept., 1937.

The experiences of a large drug company who have air conditioned 125 stores is given. The main reasons for air conditioning the stores are: (1) the comfort of the customers, (2) the health and, consequently, the temperament of employees, and (3) the greater cleanliness of merchandise. Best results are obtained when the temperature is not kept too low, and is raised as the outside temperature rises. Relative humidity is kept between 50 and 55 degrees. J.H.E.

171. **Automatic Refrigerated Vending Machines.** Anonymous. Ice Cream Rev. *21,* 2, p. 31, Sept., 1937.

Refrigerated ice cream vending machines have been developed. The machine described in the article has an ice bunker that holds 18 pounds of dry ice to refrigerate 102 ice cream novelties. The delivery operation is accomplished electrically. J.H.E.

172. **Some Attractive Ice Cream Specialties.** JOHN CLAITOR, Birmingham, Ala. Ice Cream Rev. *21,* 2, p. 44, Sept., 1937.

Directions are outlined for making ice cream specialties including fruit pie, baked Alaska, pumpkin pie, fruit cake, ice chocolate cake and nut roll. J.H.E.

173. **Some Sanitary Aspects of Ice Cream Making.** M. J. PRUCHA, Dept. of Dairy Husb., Univ. of Ill., Urbana, Ill. Ice Cream Rev. *21,* 2, p. 74, Sept., 1937.

In the summer of 1936, 480 samples of ice cream collected in different cities in Illinois had an average bacterial count of 1,000,000 per ml. Bacterial analysis of some 600 samples of unpasteurized ingredients added

to ice cream at freezing showed that these ingredients may be a real source of bacteria in ice cream. Other sources of bacteria in ice cream are reviewed. J.H.E.

174. **Manufacture of Sherbets and Ices.** S. L. TUCKEY, Dept. of Dairy Husb., Univ. of Ill., Urbana, Ill. Ice Cream Rev. *21*, 3, p. 69, Oct., 1937.

The problems involved in the manufacture of ices and sherbets and their corrections are described. J.H.E.

175. **Serum Solids—The Rôle They Play in Ice Cream.** C. A. IVERSON, Dept. of Dairy Husb., Iowa State College, Ames, Iowa. Ice Cream Rev. *21*, 2, p. 62, Sept., 1937.

Serum solids improve body and texture of ice cream but when used in excessive amounts pronounced defects occur which include, sandiness, sogginess, and poor melting quality. Serum solids may improve the flavor but as the milk solids are increased more flavoring must be added as the additional milk solids serve to subdue the flavoring. Serum solids may be sources of definite "off" flavors. J.H.E.

176. **Calculating an Ice Cream Mix Made in a Vacuum Pan.** HANS EDEL, Gehl's Guernsey Farms, Milwaukee, Wis. Ice Cream Rev. *21*, 4, p. 34, Nov., 1937.

By use of a chart accompanying the article the author gives instruction for arriving at the quantity of various ingredients to be used in making a mix in the vacuum pan. J.H.E.

177. **Ice Cream Floor Plans.** Anonymous. Ice Cream Trade J. *33*, 12, p. 8, Dec., 1937.

Floor plans for a 300,000 gallon ice cream plant showing arrangement of rooms and location of the various prices of equipment is presented. A description of the plan of operation is also given. W.H.M.

178. **Common Flavor Defects in Ice Cream and How to Control Them.** W. C. COLE, Dairy Ind. Div., Univ. of Calif. Ice Cream Trade J. *33*, 12, p. 16, Dec., 1937.

Off flavors in ice cream may be caused by (1) the use of inferior raw materials in the preparation of the mix, (2) the use of inferior flavoring materials in improper combination of flavors, and (3) the development of off flavors during storage. The use of pure vanilla extract rather than imitation vanilla and low storage temperature are recommended. W.H.M.

179. **1936 Ice Cream Production Figures.** Anonymous. Ice Cream Trade J. *33*, 12, p. 40, Dec., 1937.

The production of ice cream and sherbet by each state and for all states during 1936 as reported by the U. S. Department of Agriculture is printed in tabular form. The total production of ice cream in 4,441 plants was 248,812,000 gallons representing an increase over 1935. W.H.M.

180. The Association's Year. ROBERT C. HIBBEN, Int. Assoc. Ice Cream Mfgrs., Washington, D. C. Proc. 37th Ann. Conv. Int. Assoc. Ice Cream Mfgrs. Vol. 1, p. 41, Oct., 1937.

Proposed legislation to be considered by the 1938 legislature and how it would affect the ice cream industry is discussed.

The information service of the association has been increased and numerous requests for publications have come from manufacturers, teachers of home economics and other interested groups.

The Ice Cream Merchandising Institute is disseminating regularly information helpful to distributors of ice cream as well as consumers. M.J.M.

181. Our Industry. MADISON H. LEWIS, Int. Assoc. Ice Cream Mfgrs., The Borden Co., New York, N. Y. Proc. 37th Ann. Conv. Int. Assoc. Ice Cream Mfgrs. Vol. 1, p. 24, Oct., 1937.

The three major activities of the International Association of Ice Cream Manufacturers at present are the accounting, merchandising, and legislative work.

The accounting bureau completed two general surveys, one an analysis of advertising and the other of sales. The analysis of sales showed a very definite shift in the past years. Bulk sales have decreased, package sales have increased, and there has been a sizable increase in novelty or specialty sales.

The Ice Cream Merchandising Institute has disseminated merchandising hints and materials to association members. Talking slide films have been prepared for retail to ice cream manufacturers for dealer and consumer education. The institute staff also held a series of fourteen merchandising meetings in different parts of the country.

Federal and State legislation which affects the ice cream industry is closely followed with the view of protecting the industry to the greatest extent possible.

Preliminary statistics indicate that the 1937 sales of ice cream will produce the greatest gallonage for any year in the history of the industry. M.J.M.

182. The Dairy Industry's Future. HARRY C. CALVERT, The Pfaudler Co., Elyria, Ohio. Proc. 37th Ann. Conv. Int. Assoc. Ice Cream Mfgrs. Vol. 1, p. 64, Oct., 1937.

A proposal is made that there be periodic meetings of representatives of the International Association of Ice Cream Manufacturers and Milk

Dealers, together with the Dairy and Ice Cream Machinery and Supplies Association for the discussion of all subjects of a controversial nature. Such discussions should lead to a closer alignment among the three groups in policies and programs affecting the dairy industries' national welfare. M.J.M.

183. Fundamentals of Official Ice Cream Control as We See Them in Birmingham, Ala. L. C. BULMER, Jefferson County Board of Health, Birmingham, Ala. Proc. 37th Ann. Conv. Int. Assoc. Ice Cream Mfgrs. Vol. 1, p. 66, Oct., 1937.

The fundamentals of ice cream control are: (1) complete pasteurization of all ice cream mix to a temperature of not less than 50° F. for a period of 30 minutes, followed by immediate cooling to the aging temperature; (2) positive control, so far as possible, of ice cream mix after pasteurization so that recontamination does not occur, and (3) improvement on esthetic grounds of the wholesomeness and quality of ingredients entering into ice cream.

The practice of shipping or transporting ice cream mix and freezing it at another place is viewed with considerable alarm by the author. M.J.M.

184. Report of Simplified Practice Committee for 1937. RIDGWAY KENNEDY, JR., Chairman Simplified Practice Committee, Abbott's Dairies, Inc., Philadelphia, Pa. Proc. 37th Ann. Conv. Int. Assoc. Ice Cream Mfgrs. Vol. 1, p. 88, Oct., 1937.

Sufficient study has been made by the committee to determine that ice cream can be kept in perfect eating condition for 12 to 48 hours in the ice compartment of the household refrigerator. The committee will meet with representatives of the National Electrical Manufacturers Association for the purpose of finding, first, how many types of household refrigerators are so constructed that the ice cube tray shelves are removable, so that ice cream in the present type of bulk and brick containers may be stored in it in quantities from a pint to several quarts. Secondly, the cooperation of manufacturers of household refrigerators will be secured, if possible, in so designing every model that the machines will accommodate the present bulk and factory filled packages.

An increasing number of ice cream manufacturers are adopting the "ice tray type" of package in order to make ice cream available to consumers in a form suitable for storage in household refrigerators of the type having space inadequate for present bulk and brick ice cream packages. M.J.M.

185. Europeans Eat More Ice Cream. SAMUEL H. BAER, Blanke-Baer Extract and Preserving Co., St. Louis. Ice Cream Field *31*, 8, p. 31, Dec., 1937.

Mr. Baer, who recently returned from an European trip, states that in 1923 almost 97 per cent of the ice cream sold in Great Britain was vanilla ice cream. Since that time the volume has increased many fold with an increased percentage of strawberry and ice creams other than vanilla, though vanilla ice cream still comprises over 75 per cent of their volume.

He states that improvement in the quality of ice cream has also taken place in England, especially due to controlled composition of the mixes used, but also because of the use of better flavors as well as improved ice cream machinery from the United States.

In 1930, the author states that there were practically no wholesale ice cream manufacturers in Paris, whereas now there are seven wholesale factories there producing between 50,000 gallons and 500,000 gallons annually. The most modern of these has American equipment. In Switzerland he states that there are now five large ice cream manufacturers. He reports the per capita consumption of ice cream as follows: United States over 3 gallons; Great Britain about one-half gallon; France about 1 pint; and Switzerland about one-half pint. W.C.C.

186. Plea for Uniformity. GLENN M. YOUNG, Missouri State Dept. of Health. Ice Cream Field *32*, 1, p. 9, 1937.

The author states "all health departments, whether state or city, have the same objective—the health of the people. A great deal of confusion, unnecessary duplication and expense could be saved if there were greater uniformity in regulations governing the manufacture and sale of ice cream."

He states that due to the advent of the "counter freezer" ice cream plants present many problems to health officials that are sometimes different from those encountered in milk processing plants. Emphasis is placed upon the necessity of safeguarding the product after pasteurization, since "this is the last sanitary safeguard standing between the final product and the consumer." He continues, "Few public health officials who have the best interest of their people in mind would permit milk to be pasteurized at a plant and then be placed in cans and hauled to drug stores, restaurants, confectionaries or grocery stores for bottling. Exactly this is permitted with ice cream mix. It is even shipped long distances from one state to another. This in itself may not be so objectionable. It is how the mix is handled after reaching these places."

He outlined some of the commonly accepted practices regarding cleaning and care of equipment as a means of safeguarding the product. He points out, however, that, "one of the weakest links in the ice cream chain today is in retailing the product rather than in manufacturing it." W.C.C.

187. Fall Season Suggests New Flavor Recipes. JOHN CLAITOR. Ice Cream Field *31*, 6, p. 47, Oct., 1937.

Suggested recipes for various flavored ice creams suitable for the fall are given. The list includes grape ice, grape meringue and the following ice creams: pumpkin, coconut, persimmon, pear, honeydew, melon, and avocado. W.C.C.

188. Oat Flour as an Antioxidant. SIDNEY MUSHER, Musher Foundation, Inc. Ice Cream Field *31*, 7, p. 31, Nov., 1937.

The author claims that "avenex" (an edible oatflour product) is effective in retarding the development of off flavors in dairy products. To substantiate this claim he refers to previously published results, reproducing some of them in table form. These results also indicate that when 0.5 per cent of "avenex" is used in ice cream that a reduction of at least 25 per cent of the stabilizer content, is desirable in order to avoid overstabilized ice cream. W.C.C.

189. The Matter of Mix. W. H. BROWN, Univ. of Illinois. Ice Cream Field *31*, 3, p. 9, July, 1937; 4, p. 27, Aug., 1937.

The effects of adding various ingredients to ice cream mix after it has been pasteurized was considered in the light of sanitation and the bacterial content of ice cream. Special consideration was given pecan nut meats.

The author reviews some of the work previously published by other investigators to show that although the total number of organisms in the finished ice cream resulting from the addition of nut meats may be small, yet 50 per cent of the samples gave a positive test for *Bacterium coli*.

The author tried 69 different treatments of pecan nut meats but states that only 12 showed possibilities of being successful, and of these only 4 were recommended.

In a comparison of various methods of storing nut meats the author states "The best results from the standpoint of flavor and crispness were secured by storing in an open container at room temperature and the poorest results were secured by storing in an open container in the refrigerator room." These observations were made during the winter months.

Brief mention is also made of the preparation of peaches, bananas, and oranges for use in ice cream.

The following statements are taken from the conclusions drawn by the author:

1. The sanitary quality of pecan nut meats can be greatly improved by dipping in a 50–75 per cent boiling solution of sucrose plus 1 per cent salt followed by drying in a hot air oven. A marked improvement in the flavor of the nut meat usually resulted from such treatment.

2. The treated meats can best be stored in glassine bags at room temperature. The relative humidity should be around 42 to 50.

3. One-tenth of one per cent of sodium benzoate added to coloring materials will not inhibit the growth of bacteria.

4. The addition of 25 per cent alcohol to coloring materials will prevent the growth of bacteria and mold.

5. Coloring materials can be heated to 140°, 160°, or 180° F. for 30 minutes without injuring the quality of the colors. Additional heating, in some cases, slightly reduces the intensity of the color.

6. Strawberries and raspberries can be pasteurized to 145° F. for 30 minutes to improve their sanitary quality when used to flavor ice cream.

7. Peaches mixed with sugar can be boiled for 3 minutes without injuring the flavor of the fruit.

8. The flavor of oranges is not affected when dipped in 75–100 parts per million chlorine water to improve the bacteriological aspects of the fruit for use in ices or sherbets. W.C.C.

190. Scoops as a Source of Contamination of Ice Cream in Retail Stores. ANDREW J. KROG AND DOROTHY S. DOUGHERTY, Health Dept., Plainfield, N. J. Am. J. Pub. Health *27*, 10, p. 1007, 1937.

Bacterial counts of scoop samples were invariably higher than those of samples taken with a sterile spoon indicating surface contamination from scoops. The factors influencing the extent of contamination are discussed. Samples taken with dry scoops were lower than those taken with wet scoops. The authors conclude that if the ice cream scoops and other dispersing utensils are kept on a dry rack protected from flies, dust, and other sources of contamination, instead of in water, and rinsed with either hot or cold tap water after and before each use, the amount of contamination from the dispensing utensils can be greatly reduced. M.W.Y.

191. Does Ice Cream Pay on Retail Dairy Routes? FREDERICK E. JACOB, The Stevens-Davis Co. Milk Dealer *27*, 2, p. 30, Nov., 1937.

The author discusses the pros and cons of ice cream on retail dairy routes. The following conclusions are drawn: If you have a high class product, high class trade with good home refrigeration, reasonably long summer climate, intelligent, aggressive routemen with some bonus incentive to increase their earnings, and not too much cheap package competition, then you should be selling ice cream on your retail routes. But—if you have numerous wholesale routes, less than ten or a dozen routes, too much union domination of routemen, routemen of the old "milk and cream only" school, too short summers, not enough finances to provide the proper refrigeration, a lack of advertising and merchandising facilities, you'd better look twice before you go into ice cream on retail routes. C.J.B.

192. Walgreen's Trains Its Employees. ARTHUR BEHRSTOCK, Ice Cream Trade J. *33*, 8, p. 8, Aug., 1937.

A process, perfected over a period of years, has been developed by the Walgreen Company for training new recruits into a smoothly functioning

army of soda fountain employees. Prospective employees are judged on personal appearance, capacity to learn, and cleanliness. Once an application is approved the prospective employee is required to study a manual designed to help him learn the Walgreen way of doing things. A training course lasting from three days to a week, under the best man in the Walgreen service, is then given, followed by a trip through the commissary where he is impressed with the sanitary methods used in food preparation. An examination ends the employee's formal training. Bulletins telling of new methods are sent out and district meetings are held to discuss common problems. W.H.M.

193. **Flavor Drives Build Sales 20 Per Cent.** DWIGHT ABBOTT. Ice Cream Trade J. *33*, 8, p. 12, Aug., 1937.

Two weeks' concentration on a single flavor has produced better results than the advertising of many flavors of ice cream. Backbar dominations and colorful window displays have been used successfully by the Pangburn Company of Fort Worth, Texas, to produce increased ice cream sales during the past six months. W.H.M.

194. **New Price Policies Pay Big Dividends in Sales.** J. EDW. TUFF. Ice Cream Trade J. *33*, 8, p. 16, Aug., 1937.

The Hayden Ice Cream Company, Inglewood, California, has employed a volume dividend price plan to increase sales. Dealers are charged a base price and on the tenth of each month is paid an earned cash dividend based on volume of sales. The company has been able to maintain uniform retail price in its dealers' stores. New dealers are accepted only after a study of the area served by the store, and once the dealer is accepted the company assists him to get started properly by mailing invitations to his customers inviting them to the store for a free pint of ice cream. The dividened scale is based on actual differences in the cost of selling to the different dealers. W.H.M.

195. **An Open Letter.** MALCOLM PARKS. Ice Cream Trade J. *33*, 8, p. 20, Aug., 1937.

In a letter addressed to the ice cream manufacturer, a dealer calls attention to the many practices originated by the manufacturer which injured the dealer's business. Increased competition for retail stores and other outlets, cheap packages, and other items have only served to make it more difficult for the dealer to make a profit. The dealer states that he has decided to part company with the manufacturer and cooperate with other dealers in promoting their own manufacturing plant, and engage in other activities for the mutual benefit of the group. W.H.M.

196. Refrigeration without Accidents. EDW. R. GRANNIS, Industrial Engineer, Nat. Safety Council. Ice Cream Trade J. *33*, 9, p. 17, Sept., 1937.

Most of the accidents which occur in refrigeration plants are preventable. Proper construction of the building to provide adequate light and ventilation, location of main service switch outside of compressor room, so that electrical current may be cut off in case of emergency, and the isolation of the boiler room from the compressor or generating room by an unpierced fire-resisting wall are recommended. Improper fusion welds on ammonia vessels are sometimes responsible for explosions. A device for the relief of excessively high pressures and the piping of safety valve outlets directly to the outside atmosphere are devised. Some automatic pressure limiting device to stop the action of the compressor at a pressure not higher than 90 per cent of the maximum allowable working pressure is advised. A simple way to detect an ammonia leak is with a stick wrapped in cotton and dipped into a small vial of muriatic acid. The saturated cotton is passed along the suspected pipe lines and fittings, and upon coming in contact with the smallest amount of escaping ammonia, a thick cloud forms above the stick. Gas masks should be available for use and attendants trained in the use of rescue apparatus. Careful operation of all refrigeration equipment by experienced men is of prime importance. W.H.M.

197. Making the Mix in a Vacuum Pan. P. S. LUCAS, Michigan State College, East Lansing, Mich. Ice Cream Trade J. *33*, 9, p. 20, Sept., 1937.

"Advantages claimed for condensing the entire mix are several, such as the use of fresh milk and cream with consequent desirable effects on taste of the mix, not only through the use of fresher products but also by removal of off-flavors through heating in a vacuum." A pan in a combined market milk and ice cream plant offers a means of taking care of surplus milk. The amount of mix made and cost of raw materials are factors which determine whether the purchase of a pan is practicable or not. The cost of condensing the mix varies with capacity, in one plant with 150,000 gallons of mix it amounted to approximately 3 cents per gallon. Directions are given for calculating the amount of ingredients to use when making a mix in the pan. W.H.M.

198. A Guide for Modernization. Anonymous. Ice Cream Trade J. *33*, 10, p. 6, Nov., 1937.

This article is devoted to a discussion of refrigeration equipment. Improvements made in evaporators, compressors, and condensers are described. Improvements in evaporators have been accomplished largely by increasing

the effectiveness of the surface. Modern evaporators are operated "flooded" and air circulation in the hardening room is used to speed up freezing and reduce frost accumulation. Two or more separate compressors provide a very flexible installation, and a booster compressor is a very effective method of handling low pressure vapor. Floor space can be conserved through the use of V-belt drives. Emphasis is placed on the desirability of designing a plant so that the highest possible suction pressure can be used, consistent with temperatures required.

A good condenser should have effective heat transfer surface and facilities for easy cleaning. Attention should be given the condensing water supply. The coldest water available consistent with cost should be used. Provision for removing non-condensible gas is necessary. An automatic purger connected to the top of the receiver is superior to hand purging and will usually pay in a short time by reducing power consumption. W.H.M.

199. Oat Flour as an Antioxidant in Ice Cream. W. S. MUELLER AND M. J. MACK, Mass. State College, Amherst. Ice cream Trade J. *33,* 10, p. 24, Oct., 1937.

"The results secured in this experiment confirm previously published work which showed oat flour to have antioxidative properties when used in ice cream. The use of only 0.25 per cent of oat flour in the mix delayed the development of off-flavors during storage of the resultant ice cream, although 0.5 per cent proved more effective.

"Oat flour also has the properties of a stabilizer. The stabilizing action of the oat flour increased mix viscosity, improve the body and texture, and increased the melting resistance of ice cream. When oat flour is added to the mix, a reduction should be made in the amount of gelatin or other stabilizer used if an overstabilized condition is to be avoided. The results indicate that a reduction of at least 25 per cent of the gelatin content is desirable when 0.5 per cent oat flour is incorporated in the mix." W.H.M.

200. The Rôle of Eggs in Ice Cream. W. H. MARTIN, Kansas State College, Manhattan. Ice Cream Trade J. *33,* 10, p. 29, Nov., 1937.

A review of the literature dealing with the use of eggs in ice cream is presented. Advantage gained from the use of eggs, kinds of eggs available, amounts and method of using eggs are some of the topics discussed. W.H.M.

Other abstracts of interest are numbers 125, 127, 132, 133, 134, 135, 136, 145, 148, 151, 157, 160, 164, 201, 202, 207, 208, 209, 212, 215, 216, 217, 218, and 219.

MILK

201. The Lesser Known Constituents in Milk. G. GENIN, Paris, France. Le Lait *17,* 168, p. 820, Sept.–Oct., 1937.

For 100 molecules of fatty acid combined in the form of triglycerides in the fatty matter of milk, there are 25 to 37 molecules of oleic acid, 24 to 27 molecules of palmitic acid, while butyric, myristic and stearic represent 7 to 10 molecules each. The other acids which are not very clearly defined consist of lauric, caproic, caprylic and capric. Milk fat also contains a small proportion, generally less than 1 per cent, of polyethenoidic acids of 20 or 22 carbon atoms in their molecule. The fact that the completely saturated acids are high in comparison with the contents of these acids in other natural fats has led the author to think that in milk fat the glycerides of the lower fatty acids are formed from oleoglycerides reformed by a combined phenomenon of oxidation and reduction. When cod liver oil is added to the feed of cows, certain of the polyrthnoidic acids characteristic of that oil, pass into the milk fat which then contains 5 to 7 per cent of these acids. At the same time the yield of fat in the milk is reduced and its composition is profoundly affected. The proportion of lower fatty acids is reduced to about one-fourth their normal value, the content of palymitic, stearic, and myristic acids is likewise reduced but the content of oleoglycerides is only slightly modified. These changes in the composition of the fat are only temporary and when cod liver oil is removed from the feed the fat composition becomes normal again.

Milk possesses the power to reduce methylene blue even if it contains none or few bacteria. Skimmilk does not reduce methylene blue as the reducing substance appears to have been removed by entrainment in the cream during separation. Holding the milk at 63° C. (145.4° F.) for 30 minutes destroys the enzymes or other substances responsible for the reduction of methylene blue. Raw cream diluted with water, reduced methylene blue. A number of substances were studied for the power to reduce methylene blue. Of the substances studied only aldehydes and hypoxanthine showed definite reducing activity to methylene blue. Attempts were made to separate the reducing substances from raw milk or cream by dialysis. Negative results were obtained but after dialysis certain of the enzymes in milk became inactive. Ascorbic acid was shown to play but an insignificant rôle in the anaerobic reduction of methylene blue.

The lipase activity in milk was determined in a buffer mixture at pH 8.5 using tributyrin as the substrate. The liberated butyric acid was removed by steam distillation and titrated. The lipase activity of milk showed considerable variation from one animal to another and from one stage of lactation to another. Lipase in milk is more readily destroyed than phosphatase. There is more lipase matter in the milk serum than in the fatty matter while the opposite is true of phosphatase. It is probable that there is no relation between the lipase and phosphatase activity of milk, the latter probably being associated with the efficiency of the mammary gland. Difficulties encountered in determining the catalase activity of milk are discussed and a review of applicable methods is given. A.H.J.

202. The Effect of Light on the Vitamin C Content of Milk. S. K. Kon and M. B. Watson, Nat. Inst. for Res. in Dairying, Univ. of Reading, England. Biochem. J. *30*, 2273, 1936.

The vitamin C content of milk was determined by the titration procedure using 2–6 dichlorophenolindo-phenol reagent. Evaluations were made before and after treatment with H_2S, permitting measurement of vitamin C as reduced ascorbic acid, and, reduced and reversibly oxidized forms (total ascorbic acid) respectively.

Milk giving a positive chemical test for vitamin C fails to reduce the indophenol reagent (reduced form of ascorbic acid absent) after exposure to 1 hour February sunshine while contained in glass. The reducing power can be partially restored by use of H_2S (oxidized form produced) but losses always take place.

The reaction shown above is due mainly to visible radiation of short wave length (blue and violet) although ultra violet radiation is also probably active. Visible radiation of longer wave lengths (yellow and red) are without effect.

When the dissolved oxygen of milk (in glass) is completely replaced by an inert gas, exposure to sunlight for 2 hours is without effect upon the reaction. Pasteurization had little effect on the influence of light on the ascorbic acid values of milk as determined by the titration procedure.

When milk is exposed to sunshine of sufficient intensity, the effect of light on vitamin C may be observed in two separate reactions: (1) a reversible change of the ascorbic acid to a substance (reduced into reversibly oxidized form) no longer able to bleach the indophenol reagent unless treated with hydrogen sulphide; to effect this change both light and oxygen are essential and this reaction does not proceed in the dark, and (2) a more gradual change of the product of the first reaction to a substance which cannot be caused by H_2S treatment to give a positive test with indophenol and which is biologically inactive. The latter product is suggested to be 2 : 3 diketo-l-gulonic acid.

A pint bottle of milk exposed to sunlight on the doorstep for half an hour and then kept for 1 hour in the dark loses fully half its original antiscorbutic properties. Pasteurization by the holder method does not affect the reduced form, but destroys the reversibly oxidized form, of ascorbic acid in milk.

K.G.W.

203. Cream Plug—What Can be Done to Avoid It. Joseph Burns, Capitol Dairy, Madison, Wisconsin. Milk Dealer *27*, 3, p. 92, Dec., 1937.

The author discusses his experience with cream plug and draws the following conclusions:

To eliminate cream plug: Avoid excessive agitation. Heat and cool quickly to have short agitation time. Agitator should not go more than 70

r.p.m. Avoid excessive heating. Temperature in pasteurization of cream should not go above 150°. Avoid incubation temperatures. Cool cream immediately after separating if cream is to be held for any length of time prior to pasteurization. C.J.B.

204. The Use of Vending Machines in the Market Milk Industry. JAMES R. HUDSON, Baker-Hubbel Dairy, Peoria, Ill. Milk Dealer *27*, 3, p. 32, 48, Dec., 1937.

The author discusses the advantages and disadvantages of dispensing milk through vending machines in factories, schools, and office buildings.

C.J.B.

205. New Type Conveyor Switches Effect Substantial Savings in Modernization Program. Milk Dealer *27*, 3, p. 30, Dec., 1937.

A description of how the installation of combiner and selector type divider switches in connection with bottle conveying installations effected a substantial saving in equipment, space requirement, and production costs at the Jansen Dairy, Hoboken, New Jersey. C.J.B.

206. Sale of "By Products" Growing Factor in Milk Industry. Milk Dealer *27*, 3, p. 29, Dec., 1937.

A survey by the Milk Dealer showed that almost 87 per cent of the dealers replying to a general questionnaire reported that they sold chocolate milk, 93 per cent advised that they handled buttermilk, 67 per cent sold orange juice, 80 per cent sold cottage cheese, 67 per cent sold butter, and 45 per cent handled eggs.

Chocolate milk accounted for 2½ per cent, buttermilk for 5 per cent, orange drinks for 3.8 per cent, and tomato juice for 0.7 per cent of the total volume of sales of those dealers reached by the questionnaire. The sale of tomato juice decreased while buttermilk and cottage cheese sales increased during the past two years. C.J.B.

207. The Structure and Composition of Foods, Vol. 3, Milk, Butter, Cheese, Ice Cream, Eggs, Meat, Meat Exracts, Gelatin, Animal Fats, Poultry, Fish, Shellfish. ANDREW L. WINTON AND KATE BARBER WINTON. Published by John Wiley and Sons, 1937, pp. 524, Price $8.00.

This book is the third of a series of four books dealing with the structure and composition of foods. The first 209 pages are devoted to the structure and composition of milk and milk products, the subjects covered in this review.

Apparently the authors have endeavored to compile the important contributions in the literature showing the composition of milk and milk prod-

ucts from the viewpoint of the analytical chemist, and to present them in an organized manner to give a systematic treatise of the subject. The many references cited are given as footnotes on each page. There has been little effort made to give a complete statement regarding each phase of the chemistry of milk and milk products but rather to quote the literature. The book has its chief value as a literature review and the reader should be able to interpret certain statements and expand some of the text to secure a true impression of the facts. For example, the paragraph on "microscopic characters" of human milk states that the fat globules in human milk are smaller than those in cow's milk but fails to specify their size except that they are less than 10 μ. In the section on the fat globules in cow's milk their size is not definitely stated but data presented show them to vary "from less than 1 to over 20 μ, the average, according to L. L. Van Slyke, being over 2.5 μ."

This book will be of value primarily as a handy reference to secure some of the important publications pertaining to a special aspect of the composition of milk and milk products. A.C.D.

208. The Reliability of Flavor Judgments, with Special Reference to the Oxidized Flavor of Milk. G. MALCOLM TROUT AND PAUL F. SHARP, Cornell Univ. Agr. Exp. Sta., Ithaca, N. Y., Memoir 24, June, 1937.

A total of 1207 ten-sample series, representing 12,070 taste judgments, of sodium-chloride, sucrose, lactose, lactic-acid, and quinine-sulfate solutions were judged in these studies. Judgment was made also on 3687 additional samples of sodium-chloride and sucrose solutions.

The temperatures at which the maximum discriminatory ability for the respective solutions was found, were as follows: sodium-chloride, 21° C.; sucrose, 35°; lactose, 35°; lactic-acid, 21°; quinine-sulfate, 21°.

The sense of taste was found to be capable of discriminating as low as 1 per cent changes in concentration of the sodium-chloride solutions ranging in concentration from 0.13 to 0.20 per cent. With the sodium-chloride, sucrose, lactose, lactic-acid, and quinine-sulfate solutions, 10-per cent changes in concentration were readily detected.

The amount of substance required to produce a noticeable change in sensation was found to be but a very small percentage of the usually stated value.

The amount of retasting necessary before arriving at final judgment depended upon the concentration, its range, and the number of samples within the series. In ten-sample series of weak solutions, tasting some samples as many as ten times was found necessary.

The mean time, based upon approximately 250 trials each, required for four judges to place a ten-sample series of various solutions, was 4.4, 4.4, 6.1,

and 5.3 minutes, respectively. The mean time in placing the 1057 series was 5.04 minutes. No correlation was found between the time naturally required to place the series, and the accuracy of the judges.

After having placed a ten-sample series in order of concentration ten times, the judges had the samples sufficiently in mind to enable them to select any sample from the shuffled series and by taste alone name its concentration with remarkable accuracy. Graphs are presented showing the percentage distribution of these single-sample judgments of individual samples of several series by four judges. The mean differences between the true concentration and the estimated concentration, for solutions of sodium chloride selected at random from ten-sample series, were 0.029, 0.028, 0.019, and 0.042 per cent, respectively, for the four judges. The mean difference for 1987 individual samples tested was 0.029 per cent.

Retasting forty-sample series of sodium-chloride solutions five times improved the correlation from approximately 0.84 to 0.99. The final arrangement of a series was accomplished through end selection.

Samples of milk totaling 2152, involving 8608 taste judgments, were studied for the oxidized flavor.

The consistency of six commercial-milk judges in re-scoring milk was determined. The comparison between the percentage of all samples scored within a narrow range of scores, and the percentage of all samples re-scored with no deviation, seemed to give a more accurate indication of the consistency of scoring than did the percentage of identically re-scored samples alone. E.S.G.

209. The Handling of Milk and Milk Products. A. T. R. Mattick, Nat. Inst. for Res. in Dairying, Univ. of Reading, Ministry of Agriculture and Fisheries. Bul. 31, pp. 101, London, England. Obtainable from British Library of Information, 270 Madison Avenue, New York, Price 65 cents.

The fifth edition of this bulletin devotes considerable space to clean milk production and in addition gives an account of certain hitherto unpublished work carried out at the National Institute of Research in Dairying.

The essentials of clean milk production are presented in a clear and concise manner. Consideration is given to the cleanliness of farm workers, care of udder, method of milking and washing and sterilization of utensils and apparatus. The experimental data given relative to sterilization of equipment show the general superiority of proper steam sterilization over the use of disinfectants.

The hitherto unpublished research carried out at the Institute and presented in this bulletin includes sections on pasteurization, new media for the examination of milk, defects and off flavors in dairy products and the nutritive value of milk. Consideration is given to a comparison of the

nutritive value of raw, pasteurized and sterilized milk, the effect of pasteurization on vitamins and the effect of pasture and winter feeding on vitamins.
J.C.H.

210. Observe Changes in Ohio Milk Markets. R. W. SHERMAN, Ohio Agr. Exp. Sta., Wooster, Ohio. Ohio Agr. Exp. Sta. Weekly Press Bull. *22*, 50, Feb. 17, 1938.

During the past 10 years there has been a definite upward trend in butterfat content of milk delivered by 2500 shippers in four Ohio fluid milk markets—Canton, Cincinnati, Columbus, and Dayton. In Columbus and Dayton the average sales per day per dairy has increased. This is thought to indicate a reduction in the number of small producers. W.E.K.

211. Production of Vitamin D Milk Increasing. W. E. KRAUSS, Ohio Agr. Exp. Sta., Wooster, Ohio. Ohio Agr. Exp. Sta. Weekly Press Bull. *22*, 9, Feb. 10, 1938.

It is estimated that about 3 per cent (400,000,000 quarts) of the fluid milk sold in the United States during 1937 was vitamin D milk. In 5 years the production of vitamin D milk has been comparable to that of pasteurized milk production during the first 5 years following its inception. W.E.K.

212. Pasteurization in England and America. Editorial. Am. J. Pub. Health *27*, 9, p. 920, 1937.

In England, pasteurization has not received as much recognition as in this country although strongly advocated by leaders in the British medical and public health professions. Figures are given which indicate that market milk in large cities is much safer than in rural sections. Recent investigations at the National Institute for Research in Dairying at Reading, in Great Britain, have confirmed the fact that pasteurization has no appreciable effect upon the excellent nutritive qualities of milk. M.W.Y.

213. Fermented Beverages from Milk. ANTONIN MOULIN. Le Lait *17*, 169, p. 946, Nov., 1937.

Details are given for the making of Kefir, Yoghourt, and Koumiss.
A.H.J.

214. More Ammonia in Sour than in Fresh Milk. A. E. PERKINS, Ohio Agr. Exp. Sta., Wooster, Ohio. Ohio Agr. Exp. Sta. Weekly Press Bull. *22*, 45, Jan. 13, 1938.

Using an improved method developed by the author, it was found that whereas fresh milk contains only 3 to 5 parts of ammonia per million, sour milk may contain 20 or more times this quantity. This is probably due to the action of bacteria on the proteins of the milk. The amount of ammonia

in milk was not greatly changed by pasteurization or by storing and handling under proper conditions. W.E.K.

Other abstracts of interest are numbers 123, 124, 125, 126, 127, 128, 132, 134, 135, 144, 145, 148, 149, 151, 153, 156, 157, 158, 159, 160, 164, 165, 182, 183, 188, 196, 199, 215, 216, 217, 218, and 219.

MISCELLANEOUS

215. Minimum Wage Legislation. BERNARD SUMMER, Member of the New York Bar. Ice Cream Trade J. *33*, 12, p. 36, Dec., 1937.

A table is printed to show the powers of the Wage and Hour Commissions which have been established in various states adopting such legislation. In future articles, employee information, powers of the wage board, and violation and penalties will be tabulated. W.H.M.

216. The Employer's Job. WHITING WILLIAMS, Cleveland, Ohio. Proc. 37th Ann. Conv. Int. Assoc. Ice Cream Mfgrs. Vol. 1, p. 29, Oct., 1937.

This is a discussion of employer-employee relationships. Some problems of the employee are set forth, an understanding of which is desirable for cooperative relationships between employer and employee. M.J.M.

217. What's Around the Corner. GUSTAVUS W. DYER, Vanderbilt Univ., Nashville, Tenn. Proc. 37th Ann. Conv. Int. Assoc. Ice Cream Mfgrs. Vol. 1, p. 51, Oct., 1937.

The speaker presented his views of the functions of business and government. M.J.M.

218. Our Economic Interdependence. H. W. SUMNERS, Member of Congress, Dallas, Texas. Proc. 37th Ann. Conv. Int. Assoc. Ice Cream Mfgrs. Vol. 1, p. 80, Oct., 1937.

The principal ideas expressed in this address are that the success of our government is based on the help and cooperation of the citizens of the country and likewise, success of any specific industry is largely dependent on the successful operation of industry in general. M.J.M.

219. Present-Day Tax Problems. C. A. JAY, Vice-Pres., Industrial, Commercial and Agricultural Conference, Dallas, Texas. Proc. 37th Ann. Conv. Int. Assoc. Ice Cream Mfgrs., Vol. 1, p. 72, Oct., 1937.

The present tax situation is set forth and it is urged that tax payers give more attention to the broad problem of taxation and public expenditures. M.J.M.

PHYSIOLOGY

220. Increased Sodium Chloride Appetite in Pregnant Rats. BRUNO BARELARE, JR., AND CURT P. RICHTER, Henry Phipps Psychiatric Clinic, Johns Hopkins Hospital, Baltimore. Am. J. Physiol. *121*, 1, p. 185, Jan., 1938.

The sodium chloride appetite of twelve female rats during pregnancy was studied by the method of self-selection. On the average, animals ingested over twice as much sodium chloride solution (3 per cent) in the ten-day period after conception as in the ten-day period before conception, and ingested over three times as much in the second half of the period of gestation. The sodium chloride intake in the first ten days postpartum fell back to a level only slightly above the pregestational level. It has been reported that during pregnancy there is a diminution in both anion and cation content of the blood. Among the cations, the sodium content suffers the greatest reduction, whereas among the anions the serum bicarbonate, serum protein, and organic acid are reduced. It appears hightly probable that the animal in some way reacts to this reduction in electrolytes by voluntarily ingesting more sodium chloride.

Other changes in appetite probably occur during pregnancy. Further experiments are now being conducted with regard to this point. D.L.E.

221. The Experimental Production of Severe Homogeneous Osteoporosis by Gastrectomy in Puppies. R. A. BUSSABARGER, SMITH FREEMAN AND A. C. IVY, Dept. of Physiology and Pharmacology, Northwestern University Medical School. Am. J. Physiol. *121*, 1, p. 137, Jan., 1938.

The stomach is essential for the normal growth and development of the bony skeleton of puppies. No evidence of rickets was observed in any of the roentgenograms made of these animals. The serum calcium, phosphorus, and phosphatase of the gastrectomized puppies were usually within the normal range. The deficient ossification of the bones is apparently due to a combination of three factors, namely, (a) the absence of hydrochloric acid which normally renders the less soluble calcium salts more soluble and assists in the maintenance of an acid reaction in the intestine; (b) the absence of the reservoir function of the stomach which increases the speed of intestinal transport of food substances; and (c) the presence of an "acid tide" after eating which tends to decrease calcium retention.

Although soluble calcium salts can be absorbed, two possible etiological factors remain. One is that food calcium is inadequately absorbed. The other is that after the calcium is absorbed, it is inadequately retained. In the absence of hydrochloric acid, organic acids such as carbonic and lactic acid and possibly the bile acids, assist in the absorption of calcium. Gastrec-

tomized dogs also manifest a hyperplasia of the bone marrow, which may contribute to the production of osteoporosis. D.L.E.

222. **A Study of Protein Anabolism and Catabolism on a Nitrogen-Free Diet.** WALTER H. SEEGERS, Samuel S. Fels Research Institute, Antioch College, Yellow Spring, Ohio. Am. J. Physiol. *121*, 1, p. 231, Jan., 1938.

When rats are given a nitrogen-free diet during pregnancy the N for the young is transferred to them from the maternal reserves. If there is any wastage of N in this transfer, as a result of the young selecting a different assortment of amino acids than is liberated from the maternal reserves, it should appear in the urine. The newly formed tissue of the young will also have a catabolic phase of metabolism yielding N. The combined effect of wastage due to transfer of amino acids and that due to the catabolism of the young was measured and found to be small.

Pregnant animals have a much higher urine N coefficient than non-pregnant control animals, which suggests a higher metabolic rate. After the animals had given birth to young and had used a large quantity of their reserve protein they were continued on the diet until they died. At death the animals had lost 59.08 per cent of their original body weight and 58.42 per cent of their original N supply. As much as 64.4 per cent of the normal protein supply of the animal can be used before it succumbs, and the loss in body weight is of the same order of magnitude. D.L.E.

223. **Studies on the Pancreas and Liver of Normal and of Zinc-Fed Cats.** D. A. SCOTT AND A. M. FISHER, Connaught Laboratories, University of Toronto, Toronto, Canada. Amer. J. Physiol. *121*, 1, p. 253, Jan., 1938.

The authors mention that previous work has shown the presence of zinc in commercial preparations of insulin. More recently it has been demonstrated that the presence of minute quantities of zinc in suspensions of protamine and insulin not only increases the stability of these preparations but also prolongs their blood-sugar lowering effect. Although zinc is a necessary constituent of the diet for the normal growth of mice and rats and is present in all tissues and organs of the body in amounts almost as great as that of iron, its physiological function has not as yet been clearly demonstrated.

In trials conducted, cats fed on a high zinc diet (.25–.30 gram zinc oxide per day) for from 12 to 16 weeks showed a loss in weight averaging about 900 grams per cat. The amount of zinc per gram of pancreas and of liver was about 7 and 15 times, respectively, as great as that found in similar organs in the control group of cats. The total insulin content of the pancreas was not disturbed. Marked fibrotic changes in the pancreas of all the cats on a high zinc diet were observed. D.L.E.

224. **The Adrenals and Gonads of Rats Following Thyroidectomy Considered in Relation to Pituitary Histology.** ISOLDE T. ZECKWER, Dept. of Pathology, School of Medicine, University of Pennsylvania, Philadelphia. Am. J. Physiol. *121,* 1, p. 224, Jan., 1938.

As a result of thyroidectomy in young rats, there is retardation in kidney growth and increased weight of the pituitary in both sexes. In males there is no significant change in absolute weights of adrenals and testes, but the ratios of adrenals to kidneys, and the ratios of testes to kidneys are significantly increased. In females there is a decrease in absolute weights of the adrenals and gonads but this is proportional to retardation in kidney growth, so that the ratio of adrenals to kidneys and ovaries to kidneys are not significantly altered. Acidophiles and thyroidectomy cells can possibly be excluded as elaborators of adrenotropic hormone. By a process of exclusion, it is concluded that adrenal growth may depend upon a basophile cell.

D.L.E.

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The American Dairy Science Association was organized to advance the general welfare of the dairy industry, especially by the improvement of dairy instruction by the stimulation of scientific research in all phases of the subject and by improvement in methods of conducting extension work.

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The dues are $5.00 a year for active membership. Correspondence regarding membership and dues should be addressed to R. B. Stoltz, Ohio State University, Columbus, Ohio.

JOURNAL OF DAIRY SCIENCE

VOLUME XXI MAY, 1938 NUMBER 5

PROGRAM

THIRTY-THIRD ANNUAL MEETING

THE AMERICAN DAIRY SCIENCE ASSOCIATION

THE OHIO STATE UNIVERSITY
COLUMBUS, OHIO

JUNE 14–15–16, 1938

AND

OHIO AGRICULTURAL EXPERIMENT STATION
WOOSTER, OHIO

JUNE 17, 1938

PROGRAM COMMITTEE

C. J. BABCOCK, United States Department of Agriculture
E. N. SHULTZ, American Guernsey Cattle Club
W. E. KRAUSS, Ohio Agricultural Experiment Station
H. P. DAVIS, (Advisory Member), University of Nebraska
S. I. BECHDEL, (Advisory Member), Pennsylvania State College
T. S. SUTTON, (Chairman), Ohio State University

AMERICAN DAIRY SCIENCE ASSOCIATION

The Thirty-third Annual Meeting

Columbus, Ohio, June 14–16, 1938

AND

Wooster, Ohio, June 17, 1938

GENERAL PROGRAM

Monday, June 13

1 P. M.–4 P. M.	General Registration and Room Registration, Pomerene Hall. Dormitory rooms will not be available until Tues., June 14. Hotel and other rooms available June 13.
5 P. M.	Visitors on the Ohio State Campus are cordially invited to attend the Convocation Exercises of the University, Ohio Stadium.

Tuesday, June 14

8 A. M.–9 P. M.	General Registration and Room Registration, Pomerene Hall.
10 A. M.–12 NOON	Opening Session, Campbell Hall Auditorium, 200. H. W. Gregory, presiding. Address of Welcome: George W. Rightmire, President, Ohio State University. Response and Address: H. W. Gregory, President, American Dairy Science Association. Address.
1 P. M.–2:30 P. M.	General Session (Education), Campbell Hall Auditorium, 200. (1) The New Education, Dean Arthur J. Klein (by Invitation) College of Education, Ohio State University. (2) Measuring the Results of Instruction in the Dairy Sciences. R. W. Tyler (by Invitation), Bureau of Educational Research, Ohio State University. (3) Summer Practicum in Dairy Husbandry. A. A. Borland, Pennsylvania State College. (4) A Service Course in Dairying for Home Economics Students. K. M. Renner, Texas Technological College.
2:30 P. M.–4:30 P. M.	Manufacturing Section, Dairy Laboratories, Townshend Hall. Judging Conference for Coaches and Instructors only, L. H. Burgwald and J. H. Erb in charge.
2:30 P. M.–4:30 P. M.	Production and Extension Sections Combined, Campbell Hall Auditorium, 200.

Symposium on Nutrition.

4:30 P. M. Meeting of the Board of Directors, Campbell Hall, 203.

SECTIONAL COMMITTEE MEETINGS

4:30 P. M. Testing Committee of the Extension Section and Breeds Relations Committee of the Production Section (Combined Meeting). Horticulture and Forestry Bldg., 208. C. M. Shepardson and Floyd Johnson (Chairmen).

MANUFACTURING SECTION

Chemical Methods for the Analysis of Milk and Dairy Products, Campbell Hall, 216. L. C. Thomsen (Chairman).

Methods for the Bacteriological Analysis of Milk and Dairy Products, Campbell Hall, 217. H. Macy (Chairman).

Commitee on Quality Program, Campbell Hall, 218. W. H. E. Reid (Chairman).

Committee on Feasibility of Establishment and Maintaining a Loose-leaf Manual of Laboratory Methods, Campbell Hall, 215. H. Macy (Chairman).

Committee on the Judging of Dairy Products. Campbell Hall, 204. G. Malcolm Trout (Chairman).

Committee on Methods of Determining the Curd Tension of Milk, Campbell Hall, 102. L. H. Burgwald (Chairman).

Committee on Score Cards for Sanitary Inspection of Dairy Farms and Milk Plants, Campbell Hall, 303. C. J. Babcock (Chairman).

Committee to Study Methods for Measuring the Oxidation of Milk Fat, Campbell Hall, 304. O. F. Garrett (Chairman).

PRODUCTION SECTION

Committee on Rules for the Conduct of the Students' National Contest in Judging Dairy Cattle, Botany and Zoology Bldg., 110. I. W. Rupel (Chairman).

Committee on Awards for the Students' National Contest in Judging Dairy Cattle, Botany and Zoology Bldg., 208. A. A. Borland (Chairman).

Committee on Methods of Measuring Results of Pasture Investigations, Botany and Zoology Bldg., 209. R. H. Lush, (Chairman).

Committee on Standard Methods, Botany and Zoology Bldg., 100. A. E. Perkins, Chairman.

These same rooms will be available for a continuation of committee meetings from 8 to 9 A. M.

	Wednesday morning. Committees wishing to schedule only one meeting can be called together at either the Tuesday Evening Hour or the Wednesday Morning Hour at the pleasure of the Committee Chairmen.
8:00 P. M.	President's and Dean's Reception, Faculty Club, Adminstration Building.
	Wednesday, June 15
8 A. M.–12 NOON	General Registration and Room Registration, Pomerene Hall.
8 A. M.–9 A. M.	Sectional Commitee Meetings. Manufacturing Section Committees. Rooms as assigned for the previous evening. Production Section Committees. Rooms as assigned for the previous evening.
8 A. M.–9 A. M.	Inspection of Extension Exhibits, Horticulture & Forestry, 203, 204, 205, E. C. Scheidenhelm, Chairman.
9 A. M.–11:30 A. M.	Sectional Meetings. Production Section, Botany & Zoology Bldg., 100. Manufacturing Section, Campbell Hall Auditorium, 200. Extension Section, Horticulture & Forestry Bldg. 206.
11:30 A. M.–1 P. M.	Complimentary Dairy Luncheon. Animal Husbandry Bldg.
1 P. M.–4 P. M.	Sectional Meetings. Manufacturing Section, Campbell Hall Auditorium, 200. Production Section, Botany & Zoology Bldg., 100. Extension Section, Horticulture & Forestry Bldg. 206.
4 P. M.–5 P. M.	Sectional Business Meetings.
8 P. M.	Entertainment.
	Thursday, June 16
8 A. M.–9 A. M.	Committee Meetings. Production Section, Committee meeting rooms as previously scheduled. Manufacturing Section, Committee meeting rooms as previously scheduled.
9 A. M.–12 A. M.	Sectional Meetings. Extension, Horticulture & Forestry Bldg., 206. Production, Botany & Zoology Bldg., 100. Manufacturing, Campbell Hall Auditorium, 200.
3:30–4:30 P. M.	General Business Meeting, Campbell Hall Auditorium, 200.
6:30 P. M.	Annual Banquet. Presentation of Borden Awards.

Friday, June 17

Wooster, Ohio

10:30–12 NOON — General Session, Earl Weaver, Presiding.
Welcome, Edmund Secrest, Director, Ohio Agricultural Experiment Station.
Response, Earl Weaver, Vice President, American Dairy Science Association.
Papers:
(1) The Contribution of Production Research to the Advancement of the Dairy Industry. H. B. Ellenberger, Head, Dept. of Animal and Dairy Husbandry, University of Vermont.
(2) The Contribution of Manufacturing Research to the Advancement of the Dairy Industry. H. H. Sommer, Professor of Dairy Industry, University of Wisconsin.
(3) The Interrelationships of Production and Manufacturing Research in the Development of the Dairy Industry. Ernest L. Anthony, Dean of Agriculture, Michigan State College.

12 NOON–1 P. M. — Box Luncheon.

1 P. M. — Tours to Points of Interest at the Ohio Agricultural Experiment Station.

SECTION PROGRAMS

EXTENSION AND PRODUCTION JOINT MEETING

W. E. KRAUSS, *Chairman*

Tuesday P. M., June 14, 2:30–4:30

Campbell Hall Auditorium, 200

Symposium on Nutrition

P1—New facts in nutrition applied to dairy cattle. C. F. Huffman, Michigan State College.

P2—Vitamin E and reproduction in herbivora. B. H. Thomas, C. Y. Cannon, S. H. McNutt, and G. Underbjerg, Iowa State College.

P3—Relation of nutrition to the hormones. C. W. Turner, Missouri Agricultural Experiment Station.

P4—Rumination and paunch activity. (Moving pictures of the "darkest place in the world.") A. F. Schalk, Ohio State University.

MANUFACTURING SECTION

Tuesday P. M., June 14, 2:30–4:30

Dairy Laboratory, Townshend Hall

Dairy Products Judging Conference for Coaches and Instructors

Professors L. H. Burgwald and J. H. Erb in charge.

EXTENSION SECTION

E. N. SHULTZ, *Chairman*

Wednesday A. M., June 15, 9–11:30

Horticulture and Forestry Bldg., Room 206

Testing Committee Report. FLOYD JOHNSTON, *Chairman*

E1—Methods of presenting different extension practices in the testing project. Glen W. Vergeront, University of Wisconsin.

E2—Herd averages computed by the cow-year method versus herd averages based on cows on test at least 10 months. J. L. Lush and F. Johnston, Iowa State College.

FEEDING COMMITTEE REPORTS, K. L. TURK, *Chairman*

E3—An extension program coordinating dairying, crops, farm engineering, farm management and forestry. A. R. Merrill, Connecticut State College.

E4—A method used to illustrate the fact that higher producing cows make larger returns. W. T. Crandall, Cornell University.

E5—An extension program in grassland farming. C. B. Bender, New Jersey Agricultural Experiment Station.

E6—A method for preventing onion flavor in milk. C. E. Wylie, University of Tennessee.

PRODUCTION SECTION

Wednesday Morning, June 15, 9–11:30

Botany and Zoology Bldg., 100

H. W. CAVE, *Chairman*

Pasture, Hay and Silage

P5—Effect of fertilizer treatments on nutrients produced by pastures. R. A. Ackerman and H. O. Henderson, West Virginia Agricultural Experiment Station.

P6—A method of studying the deficiencies of alfalfa hay and the feeding value of various feeds as supplements to alfalfa hay. C. F. Huffman, Michigan State College.

P7—Air dried hay for dairy heifers. C. E. Wylie and S. A. Hinton, and J. W. Weaver, Jr., University of Tennessee and Tennessee Valley Authority.

P8—The influence of certain rations and management practices on the rate of growth of Holstein Friesian heifers. R. G. McCarty and A. C. Ragsdale, University of Missouri.

P9—The comparative nutritive value of sun cured pea vines, artificially dried pea vines and pea vine silage. J. C. Knott, R. E. Hodgson, and E. V. Ellington, State College of Washington and Bureau of Dairy Industry, U. S. D. A.

P10—Experience in ensiling partially cured alfalfa, methods used, losses sustained, and feeding value. J. B. Shepherd and T. E. Woodward, Bureau of Dairy Industry, U. S. D. A.

P11—Methods of making and feeding alfalfa molasses silage. B. R. Churchill and R. E. Horwood, Michigan State College.

P12—The influence of the quality of protein in the concentrate mixture on the production of dairy cows fed mixed hay and corn silage. G. W. Salisbury and F. B. Morrison, Cornell University.

P13—The influence of fineness of grinding on the coefficients of digestion on dairy cows. T. M. Olson and G. C. Wallis, South Dakota, State College.

MANUFACTURING SECTION

Wednesday Morning, 9–11:30

Campbell Hall, Room 200

C. J. BABCOCK, Presiding

Market Milk

M1—Some factors affecting the estimation of fat in milk by the Babcock method. W. A. Caldwell and E. O. Herreid, Vermont Agricultural Experiment Station.

M2—Cause and prevention of the decrease in fat test of composite samples. R. F. Holland, Cornell University.

M3—A study of the Resazurin test as applied to cream. Herbert Jenkins, New England Dairies, Inc., Boston, Mass.

M4—Studies of lipase action in milk. Vladimir N. Krukovsky and B. L. Herrington, Cornell University.

M5—Observations on the lipase activity in cows' milk. J. C. Pfeffer, H. C. Jackson, K. G. Weckel, University of Wisconsin.

M6—Detecting milk that may become oxidized. George R. Greenbank, Bureau of Dairy Industry, U. S. D. A.

M7—The relation of oxidation–reduction potential to oxidized flavor in milk. George R. Greenbank, Bureau of Dairy Industry, U. S. D. A.

M8—A study of the relation of titratable acidity to metal-developed oxidized flavor in milk. W. Carson Brown and R. B. Dustman, West Virginia Experiment Station.

M9—Studies on the activated flavor of milk. J. C. Flake, H. C. Jackson and K. G. Weckel, University of Wisconsin.

EXTENSION SECTION

Wednesday P. M., June 15, 1:00–4:00

Horticulture and Forestry Bldg., Room 206

J. F. KENDRICK, *Chairman*

Sire Committee Reports

E7—The use of electric fence in bull pen construction. J. W. Linn, Kansas State College. Discussion to be led by A. I. Mann, Connecticut Agriculture College.

E8—Dairy cattle breeding schools. E. E. Heizer, Ohio State University.

E9—Herd analysis and production pedigrees. S. J. Brownell, Cornell University.

J. C. NAGEOTTE, *Chairman*

Calf Club Committee Reports

E10—Four H dairy programs, requirements and recommendations. H. A. Willman, Cornell University.

E11—Relationship between the dairy extension section and the national Four H rules committee. M. L. Flack, University of Nebraska.

E12—Use of movies in dairy extension instruction. J. C. Nageotte, Pennsylvania State College.

C. J. BABCOCK, *Chairman*

Quality Committee Reports

E13—Report of Quality Committee Extension Section, American Dairy Science Association. C. J. Babcock, Chairman.

E14—Progress report of Quality Committee of Dairy Products of the Manufacturing Section of The American Dairy Science Association. W. H. E. Reid, Missouri Agricultural Experiment Station.

E15—Milk schools as a means of improving the milk supply. J. A. Nelson, Montana State College.

PRODUCTION SECTION

Wednesday P. M., June 15, 1:00–4:00

Botany and Zoology Bldg., Room 100

W. E. KRAUSS, *Chairman*

P14—The relation of certain succulent roughages to the color and flavor of milk. H. H. Tucker, O. F. Garrett, C. B. Bender. New Jersey Agricultural Experiment Station.

P15—The effect of the level of feeding dairy cows upon the flavor of their milk. J. C. Hening and A. C. Dahlberg, New York Agricultural Experiment Station.

P16—A study of some of the physico-chemical effects of soybeans on the fat in cow's milk. R. W. Bratton, W. F. Epple, J. W. Wilbur, and J. H. Hilton, Purdue University.

P17—The vitamin D. content of the milk produced by Jersey and Holstein cattle receiving the same vitamin D. intake. G. C. Wallis, South Dakota State College.

P18—Plasma magnesium studies on the growing bovine. C. W. Duncan and C. F. Huffman, Michigan State College.

P19—The normal concentration of inorganic phosphorus in the blood of lactating dairy cows and factors affecting it. A. H. VanLandingham, H. O. Henderson, and G. A. Bowling, West Virgina Agricultural Experiment Station.

P20—The carotene content of market hays and corn silage as determined by a quantitative adsorption procedure. L. A. Shinn, H. G. Wiseman, E. A. Kane, and C. A. Cary, Bureau of Dairy Industry, U. S. D. A.

P21—Relationship between carotene, blindness due to constriction of the optic nerve, papillary edema and night blindness in calves. L. A. Moore, Michigan Agricultural Experiment Station.

P22—The carotene requirements for normal reproduction. H. T. Converse and E. B. Meigs, Bureau of Dairy Industry, U. S. D. A.

P23—Vitamin A for growth and reproduction in dairy heifers. I. R. Jones and J. R. Haag, Oregon State College.

P24—Value of dried molasses and yeast for dairy calves. O. L. Lepard, P. E. Newman, and E. S. Savage, Cornell University.

MANUFACTURING SECTION

Wednesday P. M., June 15, 1:00–4:00

Campbell Hall, Room 200

C. J. BABCOCK, Presiding

Butter and Swiss Cheese

M10—Variation in the compostion of milk and the effect on solids-not-fat. H. A. Herman, University of Missouri. *(Market Milk Con't)*

M11—Studies on mold mycelia content of sour cream butter. J. Adams and E. H. Parfitt, Purdue University.

M12—The effect of temperature upon score value and physical structure of butter. W. H. E. Reid and W. S. Arbuckle, University of Missouri.

M13—Application of the Burri smear culture technic to the examination of butter. H. F. Long and B. W. Hammer, Iowa Agricultural Experiment Station.

M14—The application of the phosphatase test to the butter industry. W. H. Brown and E. H. Parfitt, Purdue University.

M15—Preliminary studies of the neutralization of cream for buttermaking. R. C. Townley and I. A. Gould, Michigan State College.

M16—The relation of milk quality to grade of Swiss cheese. L. A. Rogers, Robert E. Hardell and Fred Feutz, Bureau of Dairy Industry, U. S. D. A., in cooperation with the Ohio State University and the University of Wisconsin.

M17—Clarification of milk for the manufacture of Swiss cheese, with special reference to the use of mastitis milk. Kenneth J. Matheson, George P. Sanders, Lloyd A. Burkey, and J. Frank Cone, Bureau of Dairy Industry, U. S. D. A.

M18—Control of types of organisms in high temperature starters. Dave Nusbaum and Walter V. Price, University of Wisconsin.

M19—Methods of determining chlorine in milk and their application in the detection of mastitis. George P. Sanders, Bureau of Dairy Industry, U. S. D. A.

M20—Controlling the fact content of Swiss cheese in southern Wisconsin. Walter V. Price, University of Wisconsin.

EXTENSION SECTION

Thursday morning, June 16, 9:00–12:00

Horticulture and Forestry Bldg., Room 206

Sire Committee Reports, J. F. KENDRICK, *Chairman*

Artificial Insemination

E16—Technique—Discussion by
S. J. Brownell, Cornell University and
E. J. Perry, New Jersey College of Agriculture

E17—Use of artificial insemination in Farm Security Veterinary Associations. J. R. Allgyer, Farm Security Administration, U. S. D. A.

E18—What we can learn from Denmark in the organized use of artificial insemination. E. J. Perry, New Jersey College of Agriculture.

PRODUCTION SECTION

Thursday morning, June 16, 9:00–12:00

Botany and Zoology Bldg., Room 100

L. A. MAYNARD, *Chairman*

Milk Secretion, Metabolism, and Udder Disease

P25—Initiation of lactation in the albino rat. R. P. Reece, New Jersey Agricultural Experiment Station.

P26—Recent advances in our knowledge on the endocrine control of mammary development. E. T. Gomez and C. W. Turner, Missouri Agricultural Experiment Station.

P27—The biological assay of "mammogen". A. A. Lewis and C. W. Turner, Missouri Agricultural Experiment Station.

P28—Milk and fat production of dairy cows as influenced by thyroxine and anterior pituitary extracts. N. P. Ralston and H. A. Herman, Missouri Agricultural Experiment Station.

P29—Vitamin C metabolism in the dairy cow. W. H. Riddell and C. H. Whitnah, Kansas Agricultural Experiment Station.

P30—Fat metabolism of the mammary gland. J. C. Shaw and W. E. Petersen, University of Minnesota.

P31—An enzymatic relationship to the synthesis of milk fat. Philip L. Kelly, University of Arkansas.

P32—The effect of fasting and refeeding on milk secretion in the cow and goat. L. E. Washburn, University of Missouri.

P33—The course of fasting energy production curves in the lactating and dry dairy cow under similar environmental conditions. L. E. Washburn, University of Missouri.

P34—Nature of swelling in the cow's udder at calving time. W. W. Swett, C. A. Matthews, and R. R. Graves, Bureau of Dairy Industry, U. S. D. A.

MANUFACTURING SECTION

Thursday morning, June 16, 9:00–12:00

Campbell Hall, Room 200

C. J. BABCOCK, Presiding

By-products and Ice Cream

M21—Sodium per borate as a corrosion inhibitor for washing powders. Lawrence L. Little, Meadow Gold Milk Plant, Oklahoma City.

M22—Sterilization by irradiation—a possible new tool for the dairy industry. O. F. Garrett and R. B. Arnold, New Jersey Agricultural Experiment Station.

M23—Kefir Buttermilk. Lloyd A. Burkey, Bureau of Dairy Industry, U. S. D. A.

M24—The present status of the development of fiber from casein. Earle O. Whittier, Bureau of Dairy Industry, U.S.D.A.

M25—Whey solids in candy. Byron H. Webb, Bureau of Dairy Industry, U. S. D. A.

M26—Effect of the cold storage temperature, pasteurization treatment, and homogenization pressure on the properties of frozen condensed milk. Raymond W. Bell, Bureau of Dairy Industry, U. S. D. A.

M27—Consumer preference as related to the analysis of vanilla ice cream in Tennessee. Thos. B. Harrison, H. B. Henderson, and C. E. Wylie, University of Tennessee.

M28—The use of moving pictures in ice cream investigations. W. H. E. Reid, W. S. Arbuckle and R. J. Drew, Missouri Agricultural Experiment Station.

M29—Application of the phosphatase test to determine the efficiency of pasteurization of ice cream mix. A. J. Hahn and P. H. Tracy, University of Illinois.

M30—Influence of certain mix components upon the rate at which freezing occurs in ice cream as measured by the dilatometer method. W. C. Cole and J. H. Boulware, University of California.

PRODUCTION SECTION

Thursday P.M., June 16, 1:00–3:30

Botany and Zoology Bldg., Room 100

J. B. FITCH, *Chairman*

P35—Some factors affecting the resistance of animals to mastitis. L. A. Burkey, E. B. Meigs, G. P. Sanders, and M. Rogosa, Bureau of Dairy Industry, U. S. D. A.

P36—Preventing sudan grass poisoning. Frederick Boyd, O. S. Aamodt, G. Bohstedt and E. Truog, University of Wisconsin.

P37—A report of the occurrence of four cases of Agnathia. Fordyce Ely, H. B. Morrison, and F. E. Hull, Kentucky Agricultural Experiment Station.

P38—Maximum initial yield and persistency as inherited characters influencing total lactation yield. L. O. Gilmore, W. E. Petersen, and J. B. Fitch, University of Minnesota.

P39—Herd averages computed by the cow-year method versus herd averages based only on cows on test at least 10 months. J. L. Lush and F. Johnston, Iowa State College.

P40—Age and its influence on culling and life expectancy in dairy cows. D. M. Seath, Kansas State College, and J. L. Lush, Iowa State College.

P41—The breeding efficiency of proved (aged) sires. J. R. Dawson, Bureau of Dairy Industry, U. S. D. A.

P42—Twelve years with 1200 Holsteins. J. D. Brag, Ohio Department of Public Welfare.

P43—Artificial insemination of dairy cattle. C. L. Cole, University of Minnesota.

P44—Relation between rate of growth and milk and fat production. H. P. Davis and E. L. Willett, University of Nebraska.

MANUFACTURING SECTION

Thursday P.M., June 16, 1:00–3:30

Campbell Hall, Room 200

C. J. Babcock, Presiding

Cheese and Soft-Curd Milk

M31—A study of quality variations in summer and winter made cheeses. J. C. Marquardt, New York Agricultural Experiment Station.

M32—Starters used in Wisconsin brick cheese factories. Willard L. Langhus, Paul R. Elliker, University of Wisconsin.

M33—Methods which help to retain fat in American cheddar cheese at high temperatures. Harry L. Wilson, Bureau of Dairy Industry, U. S. D. A.

M34—X-ray diffraction analysis of white specks in cheddar cheese. S. L. Tuckey, H. A. Ruehe and G. L. Clark, University of Illinois.

M35—Studies on the ripening of blue cheese. C. B. Lane and B. W. Hammer, Iowa Agricultural Experiment Station.

M36—Studies on the vitamin A content of cheese. I. L. Hathaway and H. P. Davis, University of Nebraska.

M37—Plant experience with sonic soft curd milk. Leslie A. Chambers, Eldridge Reeves Johnson Foundation and University of Pennsylvania.

M38—The digestibility of natural and processed soft curd milks. C. C. Flora and F. J. Doan, Pennsylvania State College.

M39—The relationship between curd tension and curd size. Leslie A. Chambers and Irving J. Wolman, Eldridge Reeves Johnson Foundation and University of Pennsylvania.

M40—Artificial gastric digestion of milk. Maurice E. Hull, M. & R. Dietetic Laboratories, Inc., Columbus, Ohio.

PAPERS READ BY TITLE

Production

1. The relation of milking machines to the incidence of mastitis. Edward B. Meigs, Henry T. Converse, Division of Nutrition and Physiology, and Lloyd A. Burkey, Morrison Rogosa, and George P. Sanders, Bureau of Dairy Industry, U. S. Department of Agriculture.
2. Sudan grass hay vs. clover hay for dairy cows. C. E. Wylie and S. A. Hinton, University of Tennessee.
3. The extraction and assay of the hormones of cattle and sheep pituitaries. A. J. Bergman and C. W. Turner, University of Missouri.
4. Relation of lactic acid and glucose of the blood and glycogen in the mammary gland to milk secretion. W. E. Petersen, J. C. Shaw, University of Minnesota.
5. The carotene requirement of dairy calves. Ruel E. Ward, S. I. Bechdel, and N. B. Guerrant, Pennsylvania State College.

Manufacturing

6. Revised United States standards for quality of creamery butter. Roy C. Potts, United States Bureau of Agricultural Economics.
7. Effect of temperature and composition upon the physical properties and dipping qualities of ice cream. W. H. E. Reid, R. J. Drew and W. S. Arbuckle, University of Missouri.
8. A comparative study of metal and glass petri dish covers. Herbert Jenkins, New England Dairies.
9. Summary of experiment with the DeLaval standardizer. J. H. Frandsen, Massachusetts State College.
10. Methylene blue reduction time as an indication of the suitability of milk for the manufacturing of Swiss cheese. A. B. Erekson, C. A. Eckburg and E. Lee, The Borden Company.
11. Casein milk fat as a foam depressant in casein-clay slips. G. A. Richardson and N. P. Tarassuk, College of Agriculture, Davis, California.
12. The relationship of mastitis milk and soft-curd milk to the manufacture of Swiss cheese. Kenneth J. Matheson, Lloyd A. Burkey, George P. Sanders, and Robert R. Farrar, Bureau of Dairy Industry, U. S. D. A.

Extension

13. Texas one day shows. G. G. Gibson and E. R. Eudaly, Texas A. & M. College.
14. The Texas trench silo program E. R. Eudaly and G. G. Gibson, Texas A. & M. College.

PROGRAM FOR LADIES' AND YOUNG PEOPLES' ENTERTAINMENT

THIRTY-THIRD ANNUAL MEETING

THE AMERICAN DAIRY SCIENCE ASSOCIATION

THE OHIO STATE UNIVERSITY
COLUMBUS, OHIO
JUNE 14–15–16, 1938

AND

OHIO AGRICULTURAL EXPERIMENT STATION
WOOSTER, OHIO

JUNE 17, 1938

PROGRAM FOR LADIES' AND YOUNG PEOPLES' ENTERTAINMENT, AMERICAN DAIRY SCIENCE ASSOCIATION

COLUMBUS, OHIO, JUNE 14, 15, 16, 1938

The following program has been arranged for the pleasure of the ladies and young people attending the convention. No program has been arranged for the ladies during the day on Tuesday, believing they would appreciate the time for rest and visiting. Headquarters will be in Pomerene Hall, women's recreational building at Ohio State University, located on the east side of Neil Avenue, adjacent to and south of Mirror Lake. The lounges will be available for use at all times. This will be a delightful place to meet your friends.

The young people's program starts at 1:30 P. M. Tuesday. Capable counsellors will supervise the activities of the various age groups. The Nursery School quarters in Campbell Hall, across Neil Avenue from Pomerene Hall, will be available for the care of pre-school children during the day. Experienced persons will be in charge.

Girls who have had experience in caring for children in the evening will be available for this service at a rate of 30 cents per hour with a maximum charge of $1.00 per evening. Notice of such need should be filed with the registration clerks.

Pomerene Refectory, a delightful dining hall, will be open for meals each day. This is located on the first floor of Pomerene Hall. Service will be from 7:00 A. M. to 9:30 A. M., breakfast; lunch from 11:00 A. M. to 1:30 P. M.; evening from 5:00 P. M. to 7:30 P. M.

Mail will be received at the registration booth in Pomerene Hall and should be addressed in care of American Dairy Science Association, Pomerene Hall, Ohio State University, Columbus, Ohio.

PROGRAM

Subject to change dependent on weather and other unforseen conditions. In such a case suitable announcements will be made and notices posted at registration booth.

Tuesday, June 14, 1938

1:30 P. M. The young people will meet at Pomerene Hall, Neil Avenue, Campus, for a tour of the University Campus.
Ladies will have the afternoon free. Pomerene Hall lounges will be available.

7:30 P. M. Young people's party, Neil Hall, located one block south of University on the east side of Neil Avenue.

8:00 P. M. President's & Dean's Reception, Faculty Club, Administration Building.

Wednesday, June 15, 1938

9:00 A. M.	Pre-school children will be cared for at Campbell Hall, located across Neil Avenue from Pomerene Hall.
9:30 A. M.	Ladies will leave Pomerene Hall for a tour of the University flower gardens and green houses.
	Young people will meet at Pomerene Hall for outdoor games and contests arranged for young folk of all ages.
10:00 A. M.	Ladies will see Mr. G. H. Poesch, floriculturist, give a demonstration on flower arrangement.
11:00 A. M.	Ladies will visit the Ohio Archaeological and Historical Museum on the campus and will hear Mr. H. C. Shetrone, Director, discuss interesting facts regarding Ohio.
NOON	Lunch will be served at Pomerene Refectory in Pomerene Hall. The young people will have a private dining room where a desirable lunch will be served for 25 cents.
1:30 P. M.	Motion pictures for the young folk at University Hall Auditorium.
2:00 P. M.	Ladies will visit The Columbus Gallery of Fine Arts on East Broad Street. Mr. Philip R. Adams, director of the Art Gallery will conduct the tour. Transportation will be provided starting from Pomerene Hall promptly.
3:00 P. M.	Swimming parties for the young folk. Arrangements will be made for the use of swimming pools on the campus. Competent persons will be in charge.
4:30 P. M.	Tea for the ladies in the Lounge, Pomerene Hall.
8:00 P. M.	Entertainment for all attending the convention. University Hall Auditorium and Natatorium. This will be an evening of fun and relaxation.

Thursday, June 16, 1938

9:30 A. M.	Pre-school children will be cared for at Campbell Hall. Young people will meet at Pomerene Hall for a visit to the Ohio Archaeological and Historical Museum, University Campus.
10:00 A. M.	Ladies will leave Pomerene Hall for a tour of the M. & R. Dietetic Laboratories and the Moores and Ross Milk Plant. The Dietetic Laboratories are famous for their baby food and other nutritional products while Moores and Ross are known to have one of the finest milk and ice cream plants. Transportation will be provided for the day.
NOON	The young people will lunch together at Pomerene Hall Refectory. Lunch will cost 25 cents.
1:00 P. M.	Ladies will have a complimentary luncheon at the Columbus Country Club which is located on East Broad Street. This is one of the beauty spots of our city.
1:30 P. M.	The young people will leave Pomerene Hall for a trip to the Columbus Zoo followed by a picnic in Riverside Park. They will return to the campus about 8:00 P. M.
6:30 P. M.	Banquet at Neil House located between Broad and State Streets on High Street, across the street from the State Capitol.

ABSTRACTS OF PAPERS PRESENTED AT ANNUAL MEETING

GENERAL SESSION

2. **Measuring the Results of Instruction in the Dairy Sciences.** R. W. TYLER, Bureau of Educational Research, Ohio State University.

Measuring the results of Dairy Science instruction is important not merely as a basis for assigning grades but to identify the difficulties students are having and to determine the effectiveness of particular courses, materials and methods of teaching. In order that measurement may serve these purposes more effectively it is necessary to develop better tests and examinations. Present examinations provide evidence regarding the information students are acquiring but the tests do not indicate how far students are achieving other important objectives such as the ability to apply facts and principles, the ability to observe accurately, scientific attitude, personality, characteristics and the like. To develop a more adequate measurement program it is necessary to formulate all of the important objectives of dairy science courses clearly in order to see just what things must be measured. After these objectives have been formulated and defined it is then necessary to devise means of testing for each of these important objectives. Experimentation in other science fields has shown the possibility of developing tests for many of these so-called "intangible" objectives of education and the use of these tests has made it possible to improve teaching at many points. Samples of such tests will be described in the paper and illustrations given about their uses.

3. **Summer Practicum in Dairy Husbandry.** A. A. BORLAND, Pennsylvania State College.

The commercial dairy world frequently asserts that college graduates have insufficient practical experience to justify their being placed in positions of even moderate responsibility. Undoubtedly this criticism has been made because in certain instances the facts have warranted the complaint. We all recognize that Colleges and Universities do not recommend their graduates in dairying as finished products, but do try to give their graduates a good fundametal education in chemistry, physics, mathematics, bacteriology and economics, with some training in dairying, so that with the later acquisition of experience they may become leaders in the dairy industry. Nevertheless, when a college graduate because of his lack of experience makes a poor showing in practical dairy work immediately after leaving college, considerable criticism of the institution from which he graduated is occasioned. It is to obviate this situation to as great an extent as possible that summer practicum work has been devised.

This subject, known at The Pennsylvania State College as D.H. 17, Summer Practicum, is required of all four-year students in Dairy Hus-

bandry. The subject carries 6 credits and calls for at least 6 weeks' practical work of not less than 48 hours a week in an approved dairy plant or on an approved dairy farm, depending upon whether the student is majoring in Dairy Manufacturing or Dairy Production.

The subject carries honor points if it is conducted under the immediate supervision of the instructor in the College Creamery or the College Dairy Barn in which case the student receives no financial remuneration. If taken at a farm or plant away from the college, the student may receive as much remuneration as his services warrant. In this case he gets credit for the subject provided his work has been satisfactory and he has turned in a creditable write-up of his summer's work, but receives no honor points.

The subject is taken during the vacation period following the junior year. Before June 1st the student must submit duplicate outlines concerning the information he expects to secure on the farm or in the plant during the summer. The instructor may make suggestions for the improvement of the outlines, then retains one for himself and returns the other to the student for his guidance. During the summer the student in addition to his practical work gathers data for writing up the dairy farm or plant during the first semester of his senior year. This write-up must be turned in during the first semester. The student is graded according to the merit of his paper and the report on his work by his employer.

This system insures that every student graduating from college has had at least six weeks of practical dairy plant or dairy farm work in addition to that which he received in college. The student when he graduates has more confidence in his own ability to do creditable work than when he has had no commercial experience. Frequently his summer work leads to permanent employment since students who have made good in their summer practicum work are in many cases offered positions by firms that would not otherwise employ additional help. Finally, students with some commercial experience are in so much better shape to do satisfactory practical work that a much higher percentage of them succeed in their chosen field of work than would otherwise be the case.

4. **A Service Course in Dairying for Home Economics Students.** K. M. RENNER, Texas Technological College.

A discussion of the content material for a course in dairying to be given to students in Home Economics. An outline of such a course, which has been given at the Texas Technological College for the past eight years, will be presented. The desirability of such a course has been well established and the results secured have been very satisfactory. The course is elected primarily by students fitting themselves to do County Home Demonstration work and by those preparing for teaching in rural communities. The course includes a rather wide variety of subject matter and the field of dairying with

which the type of student mentioned naturally comes in contact in his or her field work. Practical laboratory work is given the students, enabling them to become more familiar with the methods of carrying on dairy demonstration work with rural people. Three credit hours are allowed each student.

PRODUCTION SECTION

P1. New Facts in Nutrition Applied to Dairy Cattle. C. F. HUFFMAN, Michigan State College.

As the spread between the price of feed and butterfat narrows, the interest in more economical production of butterfat increases. This means a greater use of home grown feeds, especially roughage.

Greater use of pasture for dairy cows is receiving considerable attention. The classical work of several experiment stations during the past few years has demonstrated the high nutritive effects of grasses and legumes when used before lignification interferes with digestibility. The discovery of so-called "grass factor or factors" in milk produced during the summer has also enhanced interest in pasture. The importance of using fertilizers on pastures to improve yield of nutrients has been investigated.

The conservation of roughage for winter use is one of the most important problems in dairy cattle nutrition. Artificial drying of roughages yields a good product but the cost appears prohibitive.

Several experiment stations, here and abroad, have studied grass and legume silage. The use of mineral acids in sufficient amounts to reduce the pH of the silage mass below four, preserves the nutrients especially carotene, but the cost appears high for general use.

The use of molasses in making legume silage is enjoying considerable popularity. Recent work indicates that legumes are low in fermentable carbohydrates. The molasses furnishes additional fermentable carbohydrates for the production of lactic and acetic acids. There is a diversity of opinion regarding the value of molasses for this purpose, however. Some recent investigations indicate that good legume silage can be made without any additions, and that the exclusion of air is the main factor to be considered.

Some workers in the field of energy relations have concluded that the productive or net energy value of a feed depends on the balance of nutrients in that feed. The nutritive properties of individual feeds are not always additive when they are combined in the ration, because of the associative effects of feeds in digestion and their supplementing effects in metabolism. A well balanced ration should exert an energy value about in proportion to its total digestible nutrients.

Several workers have reported results with alfalfa hay as the sole ration, which indicates efficient use of total digestible nutrients. Other investigators have reported poor utilization of the total digestible nutrients on a ration of

alfalfa hay alone, which indicates a wide variation in the feeding value of alfalfa hay.

The essential amino acids necessary in the ration of milking cows remains unsolved. The evidence is increasing that cattle are able to use nitrogen in the form of urea and ammonium salts in place of protein. Rumen flora are believed to play a rôle in this phenomenon.

Cobalt has been added to the list of essential minerals. Recent work in various parts of the world indicates that a deficiency of this element occurs among cattle, which results in anemia. Nickel and copper appear to aid in cobalt utilization.

Iron, potassium and magnesium are required by cattle but there is no evidence that a deficiency of these minerals occurs under field conditions.

Fluorine, selenium and molybdenum at fairly low levels in the ration are detrimental to health. Pasture grasses high in manganese may disturb magnesium metabolism.

Recent work indicates that the addition of yeast to the ration of calves receiving a limited amount of whole milk improved growth. The vitamin G in the yeast was believed to be responsible for this observation.

The advisability of feeding cod liver oil to dairy calves under farm conditions has been further investigated. The results are not definite.

Recent investigations have failed to show that vitamin E is required by ruminants. The possible relation of vitamin K to sweet clover poisoning in cattle is of interest.

The relation of feed of the cow to flavor and to the nutritive value of milk has also received considerable attention during the past year.

The three "mystery diseases," namely: milk fever, grass tetany and ketosis, have also been studied from the standpoint of nutrition.

P2. Vitamin E and Reproduction in Herbivora. B. H. THOMAS, C. Y. CANNON, S. H. MCNUTT AND G. UNDERBJERG, Iowa State College.

Numerous scientific data reveal that qualitative inadequacies of the diet can evoke reproductive disorders in animals. Among the vitamins the one invariably thought of in this connection is vitamin E. The deleterious effect of avitaminosis E on fertility in rats and mice and on decreased hatchability of eggs has been demonstrated. Vitamin E has been recommended recently as an adjuvant to practical rations for improving the fertility and fecundity of farm animals. Whether or not avitaminosis E will interfere with the normal development of the fetuses of herbivora as in female rats has not been demonstrated heretofore.

To determine the importance of vitamin E to reproduction among farm animals we restricted goats, sheep and rabbits during one or more generations to a vitamin E-deficient ration. Essentially the same basal feed mixture of ground grains and their by-products and finely chopped alfalfa was fed to all

animals. The vitamin E occurring naturally in this mixture was destroyed or inactivated by treating it with an ether solution of ferric chloride and subsequently aging each treated batch of feed until it acquired a decidedly rancid odor. All animals received the basal ration, water and iodized salt, *ad libitum*. The treated basal ration was fortified at feeding time with a vitamin E-free supplement compounded primarily to protect against other possible avitaminoses.

Our study of this problem has demonstrated that the dietary vitamin E requirements of different species of animals may differ markedly. For example: weaning male rats restricted to the ferric chloride treated ration exhibited initial stages of testicular degeneration in two months and became permanently sterile in eight months or less. Female rats reared similarly repeatedly resorbed their young.

Unlike rats, the reproductive behavior of male and female goats apparently was unaffected during a period of four and one-half years, although restricted at all times to the same ferric chloride treated ration. Thus, our original flock of seven goats was expanded to forty-eight without exhibiting reproductive disorders attributable to avitaminosis E. Similarly, twelve original male and female rabbits kindled 137 fully developed young in two years, however not without an occasional reproductive disorder, the cause of which we have not yet ascertained. Whether or not the vitamin E requirements of sheep compare with those of rats or goats is impossible to state definitely at present. Our studies with sheep and rabbits are being expanded.

There is a dearth of scientific data evaluating the vitamin E requirements of farm animals. Yet statements have been made inferring that vitamin E therapy will markedly decrease reproductive disorders prevalent in herds, flocks and studs. Investigations have shown that vitamin E is present in most of the ingredients commonly used in compounding livestock and poultry rations. To be sure, there is no knowledge of the changes in vitamin E activity which may occur in milled feeds through processing or aging. However, it is evident that the vitamin E requirements of certain species of animals differ markedly from those of others. Obviously stockmen should be cautioned against relying on vitamin E therapy as a panacea for decreased fertility and fecundity until additional information is obtained.

P3. Relation of Nutrition to the Hormones. C. W. TURNER, Missouri Agricultural Experiment Station.*

The relation of nutrition to the hormones which influence body growth, reproductive processes, and milk secretion is largely unexplored. The effect of improper amount or balance of the nutritive constituents of the ration has usually been interpreted as due to the absence of or deficiency in the essential

* Contribution from the Department of Dairy Husbandry, Missouri Agr. Exp. Sta., Journal Series No. 552.

components (amino acids, energy, minerals, and vitamins) for the growth of the body or the synthesis of milk. Only recently has the rôle of nutrition in relation to the secretion of the various hormones affecting these processes begun to be appreciated.

Clearly, a deficiency of essential amino acids in the ration will influence the rate of growth or milk secretion. However, if the ration is deficient in constituents, either organic or inorganic, which influence the rate of secretion of one or more hormones concerned in the process of growth or milk secretion even though the ration were adequate in respect to the precursors of growth or milk, growth and milk secretion would be limited.

The need of certain trace elements in nutrition may be due to their presence in certain hormones. Thus the requirement of iodine is probably in very large part due to the need of the thyroid gland in the synthesis of thyroxine. As knowledge of the chemical composition of the hormones of the pituitary and other endocrine glands develops, the requirement of trace elements or other endocrine glands develops, the requirement of trace elements or other essential groupings will be recognized.

The interrelation of the vitamins and the hormones will undoubtedly develop as this field develops. Already numerous studies have shown a dependence of the pituitary in the secretion of the gonadotropic hormone upon vitamin B. Without this vitamin, estrus cycles soon cease and reproduction is held in abeyance until this vitamin is added to the ration. The quality of protein appears to influence the secretion of the gonadotropic hormone and practical observations with cattle on deficient rations (quantity as well as quality) show delayed estrum until rations improve. One symptom of phosphorus deficiency is a prolonged dietary anestrus which is probably traceable to a deficiency in rate of secretion of the gonadotropic hormone.

P5. Effect of Fertilizer Treatments on Nutrients Produced by Pastures. R. A. ACKERMAN AND H. O. HENDERSON, West Virginia Agricultural Experiment Station.

Eight plots totalling 39 acres were seeded to blue grass, red top, and white clover in 1931. Three different fertilizer treatments with check, in which no fertilizer or lime was added, were duplicated. The fertilizer treatments at the time of seeding and later follow:

Check Plots	No lime or fertilizer applied.
P–L Plots	Limed to pH 6.5 in 1931. 500# 20% superphosphate in 1931, and in 1933.
P–K–L Plots	P–L as above. 100# Muriate of potash in 1931 and in 1933.
N–P–K–L Plots	P–K–L as above. 200# Nitrate of soda per year except 1937, when only 100# was applied.

Pure bred Ayrshire heifers balanced as nearly as practicable into equal age and weight groups and receiving no supplemental nutrients have been grazed on these plots. By varying the number of heifers on a plot, all pastures have been grazed as uniformly as possible. Weights were taken on two consecutive days at the time the heifers were put on the pastures, at the time of their removal, and at intervals throughout the season.

The number of pasture days and gain in weight per acre, together with the average daily gain, was kept for the heifers on each plot. From this data the total digestible nutrients was calculated by using the figures given in the Morrison Feeding Standard. Over the five year period the complete fertilizer treatment more than doubled the number of pasture days and the number of pounds of total digestible nutrients produced on an acre, and the other treatments also showed a great increase in yield.

This is a partial progress report of five years (1933–37 incl.) results in a long time extensive pasture experiment conducted by the Department of Agronomy and Genetics, Department of Dairy Husbandry, and the Reymann Memorial Farms, of the West Virginia University.

P6. A Method of Studying the Deficiencies of Alfalfa Hay and the Feeding Value of Various Feeds as Supplements to Alfalfa Hay. C. F. HUFFMAN, Michigan State College.

The trend toward a greater use of home grown rations has prompted workers at several experiment stations to study the feeding value of alfalfa alone for milking cows. Experiments at Kansas and Oregon Stations showed that alfalfa alone did not yield as much milk energy as the total digestible nutrients in the alfalfa indicated. These results were in agreement with the energy value attributed to alfalfa hay by Fraps, Armsby and European workers. Graves and associates and workers at the Nevada Agricultural Experiment Station, however, have reported efficient utilization of the total digestible nutrients of alfalfa hay when fed alone.

In a long time alfalfa feeding experiment at the Michigan Agricultural Experiment Station cows receiving alfalfa supplemented with either corn, oats, barley or a complex grain mixture failed to maintain milk production and body weights during medium and low production, when they were getting most of their nutrients from alfalfa hay. The total digestible nutrients of the alfalfa exerted a low feeding value.

In reversal experiments either of short time nature or lactation reversals, the question of residual or carry over effect appears important. With our technique cows are placed on alfalfa alone at calving and left on this ration until the stored factors necessary to balance the alfalfa for milk production are exhausted. This is indicated by a sharp decline in milk flow. When milk produced had dropped to between 20–30 pounds daily a portion of the total digestible nutrients in alfalfa is replaced by an equal amount of total digestible nutrients in the feed to be tested.

The addition of soybean oil and corn oil to alfalfa alone did not affect milk production materially. Further evidence that fat was not the first deficiency of alfalfa alone was an increased milk yield when beet pulp or solvent soybean oil meal replaced a part of the alfalfa hay.

The addition of either corn, cottonseed meal or corn gluten meal in place of alfalfa has resulted in increased milk production.

This method appears to offer an effective, inexpensive method of studying the relative milk producing value of various supplements to alfalfa hay alone.

P7. Air Dried Hay for Dairy Heifers. C. E. WYLIE AND S. A. HINTON, University of Tennessee, and J. W. WEAVER, JR., Tennessee Valley Authority.

Hay Drying

To "make hay while the sun shines" has never been very successful in "rainy seasons." Artificial drying may produce splendid hay, but large dehydration plants costing $3,500 and up are of little use to the farmer who grows from 20 to 60 tons of hay a year.

The usual procedure in making hay, for one day, is to cut the hay in the morning, windrow it about midday, and put it in the barn in the afternoon if the weather has been favorable for curing. The principle of the special barn curing system as described in this report is to let the sun and wind of the open field do about 75 per cent of the curing the first day, and finish up the other 25 per cent after the hay is safely stored in the barn.

When the hay is 75 per cent cured it still has 35 to 45 per cent moisture —twice as much as is safe for storage, but just right for handling because the leaves are limp and there is very little loss from shattering. This damp hay is stored in the loft. The loft is equipped with a system of air ducts through which air from a blower is forced upward through the hay or drawn down through the hay, as desired. This process gradually removed the excess moisture and keeps the hay at about the wet-bulb temperature. By blowing air through the hay during the day only, and allowing the excess moisture in the hay to move to the surface of stems and leaves over night, curing is completed practically as soon as by continuous blowing. The use of a solar heat absorber to heat the air blown through the hay holds considerable promise as an economical means of speeding up the curing process with the same size blower.

Equipment for fitting up a hay loft of 20 to 30 tons capacity for their system can be bought and installed for about $300.00, or less than 10 per cent of the cheapest dehydrator now available.

Feeding Trials

During the winter of 1937–38 two groups of dairy heifers have been fed the hay which has been field cured and that which has been air cured.

Analyses have been made of the hay. An experiment is being run with rats to determine the vitamin A content. The growth of the heifers in each group was determined by weight, height, and girth measurements. At the completion of this trial the data indicate no significant difference in the feeding value of the hay cured by these two methods when fed to dairy heifers. Any difference, therefore, in these two methods of curing hay would seem to be in the amount and quality of the hay harvested from the field, including hay which has been damaged by rain.

P8. The Influence of Certain Rations and Management Practices on the Rate of Growth of Holstein Friesian Heifers. R. G. McCarty and A. C. Ragsdale, University of Missouri.*

The length of time and the amount of food nutrients required to grow dairy heifers to proper size and maturity for breeding are factors of considerable economic importance to dairy farmers. Obviously, any shortening of the growth period and consequent reduction in the unproductive life of the heifer may tend to reduce the cost of raising and will result in milk production and financial returns at an earlier age. This paper presents the results of an investigation on the influence of three rations on the rate of growth of Holstein heifers. The rations used were (1) milk and alfalfa hay supplemented only with common salt, (2) a basal ration herein also referred to as a "Rapid Growth" ration, and (3) the "Rapid Growth" ration modified to include 10 per cent of dehydrated cereal grasses.

Growth in all groups was measured by gain in live weight and height at withers and compared with "normal" as presented by Ragsdale in Mo. Agricultural Experiment Station Bulletin 336.

The heifers in Group 1 averaged 17.3 per cent *below* normal in weight and 4.1 per cent *below* normal in height at withers at six months of age. At 12 months the corresponding percentages below normal were 22.1 per cent and 5.0 per cent; at 18 months 11.8 per cent and 3.27 per cent; and at 24 months 13.8 per cent and 3.8 per cent, respectively.

The heifers in Group 2 averaged 23.2 per cent *above* normal in weight and 6.6 per cent above normal in height at withers when 6 months of age. At 12 months the corresponding percentages above normal were 32.6 per cent and 4.8 per cent; and at 18 months, 33.8 per cent and 5.9 per cent, respectively.

The corresponding data for the heifers in Group 3 in terms of percentages *above* normal were 20.3 per cent in weight and 5.8 per cent in height at withers; at 12 months 26.9 per cent and 4.7 per cent and at 15 months 27.5 per cent and 4.4 per cent, respectively. The heifers in all groups are being continued and data for later ages will be reported together with feed nutri-

* Contribution from the Dairy Husbandry Department, Missouri Agr. Exp. Sta., Journal Series No. 560.

ents required for gains and certain other observations when the investigation is complete.

P9. The Comparative Nutritive Value of Sun Cured Pea Vines, Artificially Dried Pea Vines and Pea Vine Silage. J. C. KNOTT, R. E. HODGSON AND E. V. ELLINGTON, State College of Washington and Bureau Dairy Industry, U. S. D. A.

Pea vines remaining after the peas had been removed for canning were preserved for feeding purposes by field curing, artificially drying and by making them into silage. Digestion experiments were conducted with wether sheep to determine the nutritive value of the three types of forage. The results are based on six digestion trials, two for each kind of feed obtained in different years. On the basis of the composition of the dry matter and the apparent digestibility a high quality roughage feed may be produced from preserving pea vines in either of the three ways. The choice of methods used by farmers depends largely upon climatic conditions and equipment available.

P10. Experience in Ensiling Partially Cured Alfalfa, Methods Used, Losses Sustained, and Feeding Value. J. B. SHEPHERD AND T. E. WOODWARD, Bureau of Dairy Industry, U. S. Department of Agriculture.

During the period June 2 to 8, 1937, a concrete silo 14 feet in diameter was filled to a depth of over 37 feet with 115,325 pounds of partially cured, first cutting alfalfa. The object was to see if partially dried hay could be readily stored and preserved in the silo and to see how the feeding value compared with a quality of hay which with good luck might have been made from the crop. The dry matter content of the alfalfa ranged from 42 to 73 per cent, averaging 56 per cent. The alfalfa was finely chopped (cutter set for ¼-inch cut). No water or other material was added. Two large loads of freshly cut alfalfa with 70 per cent moisture were run in on top. The top was weighted down with 50 pounds of additional weight per square foot of surface area.

The silo was opened on October 20 and the silage fed from October 21, 1937, to March 18, 1938. The settled silage was 30 feet 4 inches deep.

The maximum temperature reached during the storage period 6 feet below the surface was 109.4° F.

Spoilage on top was only 7 inches deep except right at the edge where it extended down 2 to 5 feet, averaging 3 feet. The total weight of the top spoilage was 4,445 pounds. This 4,445 pounds of spoiled material is probably the equivalent of 6,350 pounds of the green alfalfa as ensiled. This 6,350 pounds is 5.5 per cent of the total amount of alfalfa ensiled.

Below the top spoilage the silage was of excellent quality and all edible except for (1) a thin coating of mold varying from about 1 inch in thickness

to a thin film next to the wall in the upper half of the silo, due to the roughness of the concrete, and (2) limited areas of moldy silage around several silo doors. The average loss in weight of 55 samples, one from each load, buried in the silo was 3.10 per cent, principally dry matter. Analyses showed that most of the dry matter lost was nitrogen-free extract.

The carotene content of the alfalfa averaged 63.6 parts per million of dry matter when put in, and 47.75 when removed. The pH of the silage ranged from 4.61 to 4.78.

Two feeding trials of 60 days each were conducted to compare the value of the alfalfa silage and U. S. No. 2 leafy alfalfa hay as the sole roughage. The cows were given all the roughage they would consume. There was some excess which was weighed back daily. Enough grain (equal parts corn, oats, and wheat bran) was fed to approximate the Haecker feeding standard.

Averaging both feeding trials: The cows getting alfalfa silage consumed 7.6 per cent more dry matter in their roughage than the cows getting alfalfa hay. The milk production of the cows getting alfalfa silage declined only 15.6 per cent in 60 days, while the milk production of cows getting alfalfa hay declined 24.7 per cent. The average gain in live weight per cow was 16 pounds in 60 days for cows getting alfalfa silage and 18 pounds for cows getting alfalfa hay.

P11. Methods of Making and Feeding Alfalfa Molasses Silage. B. R. CHURCHILL AND R. E. HORWOOD, Michigan State College.

The successful preservation of high quality roughages in the upper peninsula of Michigan has always been a major problem. The adoption of a heavy roughage feeding program together with two successive years of small grain crop failures has made the problem even more acute. Investigations are being conducted at the Upper Peninsula Experiment Station at Chatham with ensiling as a possible method of preservation. Twenty-five tons of alfalfa molasses silage were ensiled in 1935 and a like amount again in 1936, using 1.5 per cent molasses. Dairy feeding trials with these lots of silage indicated that from a feeding standpoint, a satisfactory alfalfa molasses silage could be made. The trials also indicated that the biggest problem was the method of making the silage.

Twelve lots of legume silage were ensiled in September, 1937, to determine if possible the most satisfactory method of ensiling. Lots varied from none to three per cent molasses and with sugar replacing the molasses. Lots also varied as to stage of cutting and moisture content. The per cent of alfalfa was determined for each lot. Buffers were run on the hay put in and pH determinations made of the resulting silage.

A sample of each lot of silage was sealed in an air-tight container and placed in the center of each lot in the silo. Carotene determinations are being conducted on the sealed samples, on a sample taken from the center of each

lot and on a sample of artificial dried hay similar to that which was ensiled in each lot. The results thus far indicate that the sealed samples were high in carotene while the carotene content of the samples from the silo and those artificially dried were much lower. The loss of carotene is no doubt due to the presence of oxygen. In addition the per cent moisture, protein, and total fermentable carbohydrates were determined for the hay put in and the silage fed out.

All lots were fed to eight dairy cows, feeding trials covering four 30-day periods. In the first and third periods the silage was fed as replacement for 20 pounds of hay while in the second and fourth periods the silage replace 15 pounds of the hay in the ration. The feeding trials show the palatability of the various lots and results of the different feeding periods give some indications of the most practical method of feeding the silage.

When ensiled the lots varied from 72 to 80 per cent legumes. The moisture content varied from approximately 40 to 80 per cent. The per cent protein varied from 13.56 to 16.88. Preservation of carotene varied with the different lots.

This is a preliminary report of an experiment that will be completed May first.

P12. The Influence of the Quality of Protein in the Concentrate Mixture on the Production of Dairy Cows Fed Mixed Hay and Corn Silage. G. W. SALISBURY AND F. B. MORRISON, Cornell University.

Numerous experiments have proven that for swine and poultry, or for rats (used as laboratory test animals), the quality or kind of protein in a ration may be fully as important as the amount. Thus far but little information is available as to whether or not the quality of protein is of similar importance in dairy rations composed of the common feeds.

Corn gluten feed and corn gluten meal, which are common dairy feeds, both furnish protein of low quality for swine and rats. Corn gluten feed is often the cheapest protein supplement for northeastern dairymen. It is important, therefore, to determine whether the quality of protein is a limiting factor for high-producing dairy cows fed a ration made up of the common roughages grown in the northeast, the cereal grains, and corn gluten feed or other corn by-products as the only protein supplement.

During the winters of 1935–'36 and 1937–'38 experiments were conducted at the Cornell Station in which this question was studied. Each year two groups of nine cows of nearly equal productive capacity were selected. The cows were all fed mixed hay and corn silage. In 1935–'36 the hay was of better quality and contained more clover than the hay which was fed in 1937–'38.

One-half of the cows each year were fed a "low-quality protein" concentrate mixture composed of ground yellow corn, ground oats, corn gluten feed, corn gluten meal, bonemeal and salt.

The other cows were fed a "high-quality protein" concentrate mixture. It was composed of ground yellow corn, ground oats, soybean oil meal, corn gluten feed, linseed meal, dried distillers' corn grains, cottonseed meal, bonemeal and salt.

Results. Some concern was felt when the experiment was planned concerning the palatability of the "low-quality protein" mixture. However, no difficulty was experienced until the 13th week of the first experiment. Then two cows, receiving rather large amounts of concentrates because of their high production of milk went off feed. Up to and including this, the cows on the "low-quality protein" ration had produced 96.2% as much milk as the other cows.

When the "low-quality protein" group were fed the "high-quality protein" concentrate mixture the appetite of the two cows improved greatly. They also increased in production. These results suggested that a nutritive deficiency had become apparent in the "low-quality protein" ration after it had been fed for 13 weeks.

The experiment conducted this winter was similar except that the mixed hay contained a considerably smaller proportion of clover. Up to the present time (the end of the 15th week of the experiment) the cows on the "low-quality protein" ration have produced 107.0% as much milk as the cows on the "high-quality protein" ration. On no occasion have the cows refused the "low-quality protein" concentrate mixture.

P13. The Influence of Fineness of Grinding on the Coefficients of Digestion on Dairy Cows. T. M. Olson and G. C. Wallis, South Dakota State College.

The project herein reported was concerned primarily with the effect of fineness of grinding on the coefficients of digestion, and did not consider the effect of grinding grain on the cost of grinding, nor its effect on the production of the cows.

Four lactating cows were chosen and placed in special stalls where the digestion trials were conducted in the regular manner. The six trials were for 14 days with a 7-day preliminary period. The ration consisted of equal parts by weight of corn and alfalfa. The first, third and fifth trials medium fine corn was fed, in the second trial finely ground corn was fed, in the fourth trial whole corn was fed, and in the sixth trial alfalfa alone was fed.

The results with corn indicated that the coefficients of digestion for the entire ration were somewhat higher for the finely ground than for medium ground corn. The coefficients ranged from 1 to nearly 3 per cent higher for each nutrient, including the dry matter.

When the coefficients for the corn alone were computed, the difference in the finely and medium ground corn ranged from approximately 6 per cent in case of ether extract to 27 per cent for the fiber in favor of the finely ground.

The coefficients of digestion of the whole corn in the whole ration was appreciably lower than the ground corn with every nutrient, except crude fiber, ranging from 5 per cent for crude protein to 10 per cent for ether extract.

P14. The Relation of Certain Succulent Roughages to the Color and Flavor of Milk. H. H. TUCKER, O. F. GARRETT, C. B. BENDER, New Jersey Agricultural Experiment Station.

The results of the work at this station in 1936 and 1937 indicated that there was a good correlation between high yellow color and good flavor in milk. The results also indicated that molasses grass silage might be an excellent feed for producing milk with high yellow color. Accordingly experiments were designed in 1937–1938 to observe the effect of certain succulent roughages—beet pulp, corn silage, molasses grass silage, carrot-corn silage on color and flavor.

Two separate reversal feeding trials were conducted for the purpose of studying color. In the first experiment corn silage and poor quality field cured hay, grass silage and the same hay, and grass silage as the sole roughage were studied in which the following results were obtained. The color readings for each of the rations based on the mean of the color readings for the last week of each feeding period were, corn silage and hay 5.36, grass silage and hay 5.74, and grass silage 5.85. This means an increase in color of 7.71% in the milk produced on grass silage and hay over corn silage and hay, and 9.14% increase when grass silage was used as the sole roughage as compared with corn silage and hay.

In a second experiment corn silage and hay and grass silage and hay were compared with beet pulp and hay. Each feeding period was for 3 weeks with a one week transition period between changes of feed. A ration of beet pulp and hay was used at the start and end of the experiment. When the last week of each feeding period was compared with the last week of the previous depletion period, there was a color increase from 4.494 to 4.985 or 10.9% for corn silage and hay, and an increase from 4.271 to 5.190 or 21.5% for grass silage and hay.

Carrot-corn silage made from 1 part green carrots and tops and 3 parts green corn was fed to both groups following the completion of the above experiment in March 1938. This silage when fed with field cured hay increased milk color from a beet pulp value of 4.95 to 5.23 or 5.65% at the end of 3 weeks. All cows showed a gain in milk color, with greatest gains made by cows producing milk with lowest color.

The results of the experiment on flavor show that molasses grass silage is definitely superior to both corn silage and beet pulp and that corn silage is no better than beet pulp in this respect. The average flavor score for fresh

raw milk from individual cows for grass silage was 22.28, for corn silage 20.84 and for beet pulp 20.89.

There was also a definite association of high yellow color and good flavor.

P15. The Effect of the Level of Feeding Dairy Cows Upon the Flavor of their Milk. J. C. HENING AND A. C. DAHLBERG, New York Agricultural Experiment Station.

As an outgrowth of a cooperative experiment with the United States Department of Agriculture, a study was made of the effect of different levels of feeding upon milk flavors.

The cows were divided into six groups. One group as a control was fed at the Morrison standard and the other groups were fed at levels of 20 and 10 below and 10, 20 and 30 above the Morrison standard. The judging of the flavor of the milk from all of the cows in the experiment station Jersey herd, whether they were included in the cooperative experiment or not, was continued for one year. The raw milk was judged for flavor shortly after milking and the raw, pasteurized, and pasteurized plus copper milks were judged the first, third and fifth days after milking and pasteurization.

The study of the flavors for a complete year offered opportunity to note the effect of seasonal variations on the development of oxidized flavors. Six heifers freshened during the year and the flavor of their milk was compared with that of mature cows.

The results indicate, that, the flavor of the milk or the percentage of occurrence of oxidized flavor was not influenced by the level of feeding under the conditions of the experiment.

The occurrence of oxidized flavor, as has been shown by others, was considerably less in summer months than in winter months but there was not a direct correlation between the period of feeding green cut legumes and the occurrence of oxidized flavors.

The milk from first calf heifers showed a higher evidence of oxidized flavors than milk from older cows but the data was not considered sufficient to warrant definite conclusions being drawn.

P16. A Study of Some of the Physico-Chemical Effects of Soybeans on the Fat in Cows Milk. R. W. BRATTON, W. F. EPPLE, J. W. WILBUR AND J. H. HILTON, Purdue University.

Previous investigations at this Station have shown that raw soybeans, when fed in amounts equal to 25 per cent of the grain ration, effect a measurable increase in the fat test of the milk produced.

It seems logical, therefore, that this change in fat test would be accompanied by changes in the numbers of fat globules present or their size. Furthermore the chemical composition of the butterfat might change with the variation in the fat test.

A feeding trial has been in progress with the view in mind of determining some of the physical and chemical manifestations of this change in fat test.

Two cows were fed progressively on experimental rations consisting of one part corn, one part oats, and two parts roasted soybeans; one part corn, one part oats, and two parts raw soybeans; one part corn, one part oats, and enough soybean oil meal and soybean oil to make the protein and fat levels approximately equal to those of the raw soybean ration. The control ration consisted of one part corn, one part oats, and 1.5 parts soybean oil meal. Good quality alfalfa hay was fed as the sole source of roughage.

Microscopic examinations of the milk have yielded no conclusive evidence as to the probable effect of soybeans on either the total number or size of the fat globules. Sizes of the fat globules ranged from .1 to 15 microns in diameter, with the mean size between 1.5 and 3 microns. The total frequency ranged from 1.4 to 4.6×10^9 per ml.

Chemical analyses of the milk fat, including the iodine number, the thiocyanogen number, and the Reichert Meissl number, have yielded some information regarding the chemical nature of the increase in fat test.

The following table gives the average fat tests, the iodine and thiocyanogen numbers of the milk fat, and the calculated percentages of linoleic and oleic acid produced when the various soybean rations were fed.

Ration	% fat	I-no.	SCN-no.	% linoleic	% oleic
Soybean oil meal (check)	3.36	39.4	36.4	3.3	37.4
Soybean oil meal + soybean oil	3.58	45.8	41.7	4.5	42.1
Roasted soybeans	3.81	51.0	43.5	8.3	40.3
Raw soybeans	*3.88	43.2	39.1	4.5	39.2

* This slight increase in test over that secured when roasted beans were fed was caused primarily by an abnormally high test of one cow while she was sick during a period when raw soybeans were fed.

The figures in the above table indicate that the increase in fat test secured by feeding either raw or roasted soybeans was of about the same magnitude, but the composition of the resulting fat was noticeably different.

It is interesting to note further that when soybean oil was fed, the increase in test was not so great as when either raw or roasted soybeans were fed, but the composition of the fat resembled that produced by feeding raw soybeans.

The Reichert Meissl numbers which were determined, decreased when the iodine numbers increased. This change accompanied the increases in fat tests and indicates a diluting affect on the glycerides of the volatile fatty acids by some other fatty acids.

Additional studies are being made to determine if the increase in test is due to the oil in the soybeans or some other factor in the soybeans.

P17. The Vitamin D Content of the Milk Produced by Jersey and Holstein Cattle Receiving the Same Vitamin D Intake. G. C. WALLIS, So. Dak. State College.

The paired-feeding method is being employed with representative animals from the Jersey and Holstein breeds. Each animal is fed vitamin D at a known and constant level throughout the lactation period from natural food sources, chiefly alfalfa hay. The food intake is controlled so that each animal in a pair received the same amount of vitamin D. Butterfat samples representing the milk for a 4–6 day period are obtained from each animal at monthly intervals throughout the lactation period for vitamin D assay. The project will be continued until data is available from three or four pairs of animals. In this paper the results from one Jersey and one Holstein, which constitute the first pair, are being reported.

The alfalfa hay contained 1588 I.U. of vitamin D per pound. It was fed to each cow at the rate of 12 pounds per day making a vitamin D intake of approximately 19,000 I.U. daily throughout the lactation period. The vitamin D potency of the butterfat from the Holstein cow decreased from 0.43 I.U. per gram in the early part of the lactation to about 0.25 I.U. near the end. The Jersey showed the same tendency but the potency was always higher being 0.63 I.U. per gram in the flush of the lactation and 0.43 at the close. The decrease in the potency of the fat was practically counterbalanced in both cases by the increase in the percentage of fat in the milk as the lactation progressed so that the vitamin content per quart of milk was strikingly uniform throughout the lactation. The vitamin content of Jersey milk fluctuated between 27 and 33 I.U. per quart whereas the Holstein milk varied between 8 and 12 I.U. per quart. However, because of the larger milk production of the Holstein cow, the total amount of vitamin D recovered in the milk was practically the same for both cows. Of the 19,000 I.U. in the feed, the amount recovered decreased from about 1.8 per cent in the early part of the lactation to about 0.50 per cent toward the end.

P18. Plasma Magnesium Studies on the Growing Bovine. C. W. DUNCAN AND C. F. HUFFMAN, Michigan State College.

Determinations of magnesium were made on the blood plasma of 107 normal calves at intervals of 1 to 2 weeks over a period of 3 years and values were obtained for the mean concentration of magnesium for the first 18 months of life. The magnesium value showed fairly close agreement from month to month and a definite tendency to increase up to 12–13 months of age. The change in level was accompanied by a series of rhythmic variations which extended over several months. The mean value from the 2286 observed values was 2.414 ± 0.005 mg. per 100 cc. of blood plasma (range 1.62–3.83 mg.) and 79.7 per cent of the values were between 1.895 and 2.795

mg., whereas 72.5 per cent of all of the values actually occurred within the limits established by ± 1 standard error of prediction.

The same magnesium value recorded above were rearranged, without respect to age, into the respective calendar months in which they were taken and the influence of the astronomical seasons noted. Straight lines were fitted to the 6 means of January–June, inclusive, and July–December, inclusive, and the slope of each line represents the general path of plasma magnesium throughout the year. From November through April there was very little change in the mean but during May and June there was a rapid and steady decline. From July to November the downward trend was reversed and a steady increase in the concentration of magnesium took place. This decline and increase is particularly striking in view of the fact that some of the values were obtained from calves which did not have access to sunlight and were receiving different types of rations, so that the fluctuations in plasma magnesium are not referable to seasonal changes in the ration.

It has been shown that the concentration of magnesium can not be regarded as constant. The range of the so-called normal variation is sufficiently wide to include many variations that occur under pathological and physiological conditions. It is also evident that fluctuations in the plasma magnesium content of the blood of growing calves are to be expected as normal occurrences.

P19. The Normal Concentration of Inorganic Phosphorus in the Blood of Lactating Dairy Cows and Factors Affecting It. A. H. VANLANDINGHAM, H. O. HENDERSON AND G. A. BOWLING, West Virginia Agricultural Experiment Station.

Inorganic phosphorus has been determined on more than 200 composite samples of whole blood taken from twenty-two Holstein dairy cows at eight-week intervals over a period of two years.

The animals were divided into three groups depending upon the type of ration and management. All rations consisted of a grain mixture, supplemented with 2% bone meal, and alfalfa or timothy hay with or without corn silage. These rations were calculated to supply liberal amounts of digestible crude protein, total digestible nutrients, calcium and phosphorus.

There was no appreciable change in the inorganic phosphorus content of the blood throughout the first lactation, but there was a considerable drop during the last months of gestation preceding the second lactation period. The inorganic phosphorus in the blood was low during the first three months of the second lactation period. Again there was a drop in blood composition during the latter months of pregnancy preceding the third lactation period. During the first three months of the third lactation the blood phosphorus was low, but during the fourth to fifth months it rose to about the normal level followed by a slight decline throughout the remainder of the period.

There was a considerable decline in blood phosphorus from the first to the third lactation after which there was no appreciable change in blood composition. Sixty-two composite samples of whole blood taken during the first lactation averaged 4.95 mgs. per 100 mls., 51 samples taken during the second lactation averaged 4.81 mgs., 31 samples taken during the third lactation averaged 4.35 mgs., and 27 samples taken after the third lactation averaged 4.33 mgs. of inorganic phosphorus per 100 mls.

There was a slight negative correlation between the inorganic phosphorus content of the whole blood and the average daily milk production in pounds for the entire lactation period.

The inorganic phosphorus in the blood of lactating dairy cows was slightly lower during the winter and early spring than during the summer and early fall. This difference was not related to feed or management of the animals.

P20. The Carotene Content of Market Hays and Corn Silage as Determined by a Quantitative Adsorption Procedure. LEO A. SHINN, HERBERT G. WISEMAN, EDWARD A. KANE AND C. A. CARY, Bureau of Dairy Industry, United States Department of Agriculture.

When the pigments that occur with the carotene in the feed are separated from it by a modification of the Willstätter and Stoll procedure, using 92 per cent CH_3OH in the removal of the xanthophyll, the carotene content in milligrams per kilograms with U. S. No. 1 alfalfa hay varies from 19 to 121, average 43; with U. S. No. 3 alfalfa, from 1 to 11, average 4.5; with U. S. No. 1 timothy hay, from 8 to 36, average 21; with U. S. No. 3 timothy hay, from 1 to 12, average 5.5; and with corn silage, from 1 to 40, average 13.7.

With none of these materials does the spectral absorption curve for the pigments in the "carotene" fraction correspond with that of β-carotene within the limit of experimental error. The absorption is relatively too high at wave lengths shorter than 450 mμ, and too low at wave lengths longer than this to correspond with this carotene.

If these carotene fractions are filtered on adsorption columns in such a way as not to destroy any of the pigments in them, two colored fractions may readily be obtained—one with the spectral absorption of β-carotene and the other, probably made up of several pigments, with a spectral absorption that would account for the discrepancy between that of the original unfiltered sample and β-carotene; and the amount of carotene obtained in this way from the original, unfiltered carotene fractions is the same as that calculated, from the spectral absorption curve of β-carotene and that of the impurity removed by filtration, to be present in them. An adsorption procedure has, therefore, been devised for the routine determination of carotene in feeds. For U. S. No. 1 alfalfa hay, it gives results on an average of 18

per cent lower than those above; with No. 3 alfalfa, about 39 per cent lower; with U. S. No. 1 timothy hay, 25 per cent lower; with No. 3 timothy hay, about 40 per cent; and with corn silage, 30 per cent lower. The above figures, corrected accordingly, probably represent more nearly the vitamin A potency of these feeds.

P21. Relationship Between Carotene, Blindness Due to Construction of the Optic Nerve, Papillary Edema and Night Blindness in Calves. L. A. MOORE, Michigan Ag. Exp. Station.

For the past 20 years various experiment stations have noted blindness in calves associated with rations where poor quality or no roughage was fed. The condition is also associated with poor reproduction. Previous work from Michigan has shown that the blindness is associated with a constriction of the optic nerve where it passes through the optic foramen. Further work with calves has shown the blindness is preceded by papillary edema and generally by night blindness.

Excellent work from California has shown the association of vitamin A and night blindness in cattle. Various workers have associated vitamin A deficiency and blindness due to constriction of the optic nerve although no direct proof has been produced. Two Holstein calves placed on a vitamin A deficient ration (a ration which had previously produced the blindness) and fed crystalline carotene dissolved in cottonseed oil in quantities sufficient to keep the blood plasma carotene level well above a lower limit of 0.13 gammas per cc. have not developed night blindness, papillary edema or blindness due to constriction of the optic nerve. It therefore appears that vitamin A deficiency is the cause of the development of these conditions.

In mature cows night blindness and papillary edema develop but blindness due to constriction of the optic nerve does not develop due to the fact that the optic canal is well calcified and is not growing in length.

In calves blindness due to constriction of the optic nerve and papillary edema are associated while night blindness is a separate process but due to the same deficiency.

P22. The Carotene Requirements for Normal Reproduction. H. T. CONVERSE AND EDWARD B. MEIGS. Bureau of Dairy Industry, United States Department of Agriculture.

In 1936 Meigs and Converse reported before this society the results of their work on the carotene requirements of dairy cattle for reproduction and lactation. The roughages which furnished the carotene for the animals used in that work constituted approximately half the ration. With U. S. No. 1 alfalfa hay there was a normal number of normal calvings; with U. S. No. 3 alfalfa or timothy hay, all calvings were abnormal where the animals had been on these rations for 5 months or more; and it was reported that with

U. S. No. 1 timothy hay or U. S. No. 1 clover hay (or clover light timothy mixed) less than 50 per cent of the calves were normal at birth. The average daily carotene intake of the cows on the No. 1 timothy and No. 1 clover rations was probably about 50 milligrams per animal or 100 micrograms per kilogram of body weight. This was calculated by using average figures for these two grades of hay. As there is a wide variation in the carotene content of hays of the same grade, and as considerable loss of carotene occurs during their storage, it seemed desirable to obtain more definite information on the effect of hays supplying approximately this apparently critical level of carotene.

We have, therefore, noted the carotene intake, during the last 3 months of gestation, of all cows on rations of grain and No. 1 timothy hay or grain and No. 1 clover or clover mixed hays. Seven calvings have occurred. All have been apparently normal. The carotene intake was from 80 to 130 milligrams daily or from 178 to 260 micrograms per kilogram or body weight. Two other cows on a ration containing clover hay had a daily carotene intake for the last 3 months of gestation of about 30 milligrams (60 to 70 micrograms per kilograms of body weight) gave birth to very weak calves, though one did survive. One first-calf heifer on timothy hay received about 90 milligrams of carotene daily at the start of gestation and about 42 milligrams daily at calving. This carotene intake represented 340 micrograms per kilogram of body weight at conception and 114 micrograms per kilogram at calving. The calf was born dead. As previously reported, no cows on our lower grades of timothy hay have calved normally.

Our amounts of carotene for safe calving are therefore somewhat larger than those reported by Guilbert and Hart of California.

We conclude that for normal calving, cows should receive during the last months of gestation 80 to 100 milligrams of carotene daily. If the daily carotene intake is as little as 60 milligrams per cow there will probably be a considerable proportion of dead calves.

P23. Vitamin A for Growth and Reproduction in Dairy Heifers. I. R. JONES AND J. R. HAAG, Oregon State College.

The possibility of dairy heifers being fed rations too low in vitamin A for good growth, normal reproduction and well-being has been indicated by the investigations of several workers in recent years.

In the fall of 1936, thirty purebred dairy heifers were placed on a basal ration consisting of poor quality oats and vetch hay and a grain mixture composed of barley, oats, wheat bran, linseed oil meal, bone meal and salt. The oats and vetch hay was quite mature when cut and was rained upon and bleached during the curing process. This hay was found to contain about nine parts of carotene per million. Preliminary vitamin A assays with rats gave results of essentially the same order.

The heifers, ranging in age from 6 to 20 months and previously maintained on good rations, were divided into two similar groups, one of which was fed in addition to the basal ration, a vitamin A supplement in the form of salmon oil at the rate of 5 c.c. per hundred pounds live weight daily. Rat assays indicate that the salmon oil has a vitamin A potency of about two times that of U. S. P. XI Reference Cod Liver Oil.

All heifers were fed individually and accurate records kept of feed consumption, breeding behavior, health and growth. The heifers of both groups continued to grow at essentially the normal rate during the 6 months' period.

The reproduction records of the two groups of heifers have been fairly normal with a possible benefit to be attributed to the salmon oil feeding. Three heifers receiving salmon oil and 2 controls successfully continued pregnancy from about the fourth month until 3 to 4 weeks before calving when they were given a better quality hay and corn silage. Five salmon oil fed heifers and 2 controls became pregnant while receiving the experimental rations. Delay in estrus and failure to conceive at service were somewhat more prevalent in the control group.

The heifers that had not freshened were pastured for 6 months in the summer of 1937. Five heifers calved normally during this period. Five salmon oil and 11 control heifers became pregnant while on pasture.

In the fall of 1937, fourteen of the original heifers, 7 in each group, were again placed on similar experimental rations. Also, an additional 24 heifers averaging 9 months of age, were paired into two groups. The hay fed in 1937–38 was a mixture of poor quality oats and vetch and sudan grass with an average carotene content of about 11 parts per million.

After 4½ months' feeding, the weights and heights of all animals are normal. The heifers bred while on pasture have successfully completed pregnancy. Other reproduction records are incomplete. No harmful effects have been observed as the result of feeding as much as 60 c.c. of salmon oil daily.

The experimental results would seem to indicate that a comparatively low vitamin A ration will not result in serious disturbances in dairy heifers when fed over a period of about six months either preceded or followed by a pasture period.

P24. The Value of Dried Molasses and Yeast for Dairy Calves. O. L. Lepard, P. E. Newman and E. S. Savage, Cornell University.

In view of the introduction of dried molasses and yeast as a dairy feed and previous published results concerning the value of cereal yeast for dairy calves, studies were made to determine the relative replacement value of dried molasses and yeast for skimmilk in dairy calf starters.

Two lots of 5 calves each were raised by the calf starter method. Each calf received 350 lbs. of whole milk allotted over the first 7 week period. Calf starter was fed free choice to a maximum of 4 lbs. per day for the first

16 weeks. As soon as the calves reached 4 lbs. of calf starter a heifer ration was fed to a maximum of one pound per day until the calves were 16 weeks of age. At 16 weeks of age the calf starter was discontinued and the heifer ration fed to a maximum of 5 lbs. per day for the remainder of the trial. Alfalfa heavy grass mixed hay, U. S. Grade No. 2, was fed free choice throughout the experiment. All experimental trials were of 20 weeks' duration.

To test the value of dried molasses and yeast as an ingredient in calf starter one group was fed 5% dried molasses and yeast replacing an equal amount of dried skimmilk in a previously tested formula containing 20% dried skimmilk. The other group was fed 7.5% dried molasses and yeast replacing 5% of dried skimmilk in a calf starter formula containing 10% dried skimmilk.

The group receiving 5% dried molasses and yeast consumed 227.1 lbs. of total digestible nutrients per 100 lbs. of gain as compared with 238.5 lbs. of total digestible nutrients for the check group containing no yeast. The average daily gains from 2 weeks of age for this group was 121.6% normal as compared to 110.1% normal for the check group.

The group receiving 7.5% dried molasses and yeast consumed 231.9 lbs. of total digestible nutrients per 100 lbs. of gain as compared with 254.1 lbs. of total digestible nutrients for the check group containing no yeast. The average daily gains from 2 weeks of age for this group was 118.7% normal as compared to 112.2% normal for the check group.

All calves appeared normal and in a thrifty growing condition throughout and at the end of the experimental periods.

Dried molasses and yeast is hygroscopic in nature and contains 32% mineral ash. Each of these factors may offer some difficulty when large amounts are used in a ration.

P25. Initiation of Lactation in the Albino Rat. R. P. Reece, New Jersey Agricultural Experiment Station.

A number of investigators have reported the failure to initiate lactation in the albino rat, either with an anterior lobe extract or with lactogen. Two possibilities have existed to account for this non-functional responsiveness: first, that the experimentally developed mammary glands of the albino rat were not developed to a state entirely comparable to that which takes place during pregnancy and secondly, that the albino rat was non-responsive to lactogen.

This problem has been re-investigated. Pseudo-pregancy was induced in rats by injecting a gonadotropic hormone. On the 12th day following the induction of pseudo-pregnancy the animals were ovariectomized and a mammary gland removed. Experimental animals were then injected with pituitary glands, anterior lobe acetone dried powder or lactogen every eight

hours until six injections had been made. Three or four hours following the last injection the animals were sacrificed and their mammary glands observed macroscopically and microscopically. Control animals were employed also and they received the same treatment as experimental animals except that no injections were made following ovariectomy.

Lactation was observed in none of the control animals. In the experimental animals a small amount of milk was observed following the injection of lactogen, pituitary glands from spayed female rats and pituitary glands from normal rats. A fair amount of lactation was observed in experimental animals following the injection of pituitary glands from normal and ovariectomized rats which had been injected previously with estrogen. In not one case was lactation observed which was comparable to which occurs in the parturient female rat.

A group of pseudo-pregnant rats were then injected daily with 200 i.u. of estrogen during the pseudo-pregnancy period. The experimental animals were then injected with an acetone dried powder made from cattle pituitaries. In all cases lactation was observed which was comparable to that observed in the rat following parturition. Lactogen injections into similarly treated rats resulted in inconsistent results.

These observations demonstrate that the mammary glands of rats are functionally responsive to injected pituitary tissue and emphasize again the importance of anterior pituitary hormones, other than lactogen, in initiating lactation.

P26. Recent Advances in Our Knowledge on the Endocrine Control of Mammary Development. E. T. Gomez and C. W. Turner, Missouri Agricultural Experiment Station.*

Until recently, development of the mammary gland had been assumed to be stimulated directly by ovarian hormones. Gomez, Turner and Reece (1937) first demonstrated, that while normal development of the mammary gland could occur only in the presence of functional ovaries, the action of ovarian hormones (estrogen and progestin) is indirect, by way of the anterior pituitary gland. These observations have since been confirmed and extended to several species of laboratory animals (Gomez and Turner, 1937–1938). Studies with hypophysectomized rats, rabbits, cats, and guinea pigs maintained under strict hygienic regimen and nutritive care have shown that administration of estrogen and/or progestin daily for periods ranging from 20 to 30 days was ineffective in stimulating growth of the mammary gland. Similarly, administration of somewhat purified preparations of anterior pituitary hormones, including the thyrotropic, adrenotropic, gonadotropic,

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and lactogenic hormones; the thyroid (thyroxin) and adrenal cortical (eschatin) hormone; and acetone dried or fresh anterior pituitaries of sheep alone and in combination with estrogen or estrogen and progestin was ineffective in stimulating the growth of the mammary gland. These observations were interpreted as indicating that estrogen and/or progestin stimulates the production of a specific mammary gland growth-promoting hormone which in turn exerts a direct action upon the mammary gland. This hormone entity has been called "Mammogen." According to the above hypothesis, the pituitaries of animals during estrum and pregnancy or those which have been receiving estrogen treatments should contain a high concentration of this mammogenic hormone. Sufficient evidence has now been accumulated to confirm and extend this hypothesis.

Implanation of one adult male rat pituitary daily for 20 days produces extensive arborization of ducts and proliferation of the lobule-alveolar system of the mammary gland of hypophysectomized immature male and female guinea pigs. The donor rats have previously estrogen treatments daily for 10 to 20 days. On the other hand, implanation of one adult normal male rat pituitary daily for 30 days is effective in stimulating the mammary glands of hypophysectiomized guinea pigs. Daily administration of 50 mgs. of macerated anterior pituitary from pregnant cattle for 20 days or more causes the growth of ducts and proliferation of the lobule-alveolar system of the mammary gland of gonadectomized immature female rats and rabbits. This growth is comparable to that observed in late pregnancy.

Summary.—The normal development of the mammary gland is under the direct influence of a "mammogenic hormone entity" of the anterior pituitary gland. This hormone entity is elaborated in ample amount by the pituitary gland, to produce physiological effects upon the mammary gland following injection of ovarian hormones or during pregnancy.

P27. The Biological Assay of "Mammogen." A. A. Lewis and C. W. Turner, Missouri Agricultural Experiment Station.*

The normal male mouse at about puberty (10 to 25 grams body weight) has 8 to 10 very rudimentary mammary glands, without teats. These consist of one to three thin ducts with perhaps a few short side-branches.

Subcutaneous injection of fresh, macerated anterior lobe tissue from pregnant animals in water in the lumbar region of normal male mice (castration is unnecessary) once daily for a minimum of four days has been found to stimulate the mammary glands to the development of thick ducts, numerous side branches, and large club-like, dark staining end-buds. Not all of the glands on a mouse skin will develop to the same extent. Those at the anterior end usually respond most readily.

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The total dosage necessary to secure such development can be reduced by injecting smaller amounts daily for six days. The mice are then killed on the seventh day and the skins mounted on cork and placed in a fixative. The interior fascia is later removed, stained, and examined under a binocular microscope. One or more well developed glands with large end-buds, denoting rapid growth, is considered a positive response. Because of variability in the mice, response should be secured in 50 ± 10 per cent of ten mice.

Formulative of an assay technique is facilitating determination of comparative concentrations of "mammogen" in different extracts, in the pituitaries of different species, and at different stages of pregnancy. Work is also progressing on methods of chemical extraction and purification. The response to "mammogen" of other mammalian species is also being investigated.

Summary.—The male mouse, of between 10 and 25 grams body weight, which invariably has very immature glands, has been found to be an excellent assay subject for the mammogenic factor of pregnancy pituitaries. The proposed assay unit is the total amount of pituitary tissue or extract, injected subcutaneously for six successive days, necessary to secure pronounced end-bud development on at least one gland each of 50 ± 10 per cent of ten normal 10 to 25 gram male mice.

P28. Milk and Fat Production of Dairy Cows as Influenced by Thyroxine, and Anterior Pituitary Extracts. NOEL P. RALSTON AND H. A. HERMAN, Missouri Agricultural Experiment Station.*

Recent experiments at this and other stations have demonstrated an augmentation of milk and fat secretion when cows are administered thyroxine, and extracts of the whole anterior pituitary body. In general, previous experiments have been of short duration, but have served to further emphasize the relation of the endocrine secretions with respect to the functioning of the mammary gland.

The present project has as its objective (a) a further study of the influence of thyroxine and other thyroid substances on milk and fat secretions; (b) the effect of extracts of known potency from the whole anterior pituitary, on milk and fat secretion; and (c) the relative effects of some of the fractions of the anterior pituitary on milk secretion. Included in this study is the determination of the minimum dosage of the respective hormone substances required to bring about a maximum response in increased milk and fat yield at the various stages of lactation. Cows in the various stages of lactation, and of high, low and intermediate producing ability have been selected for these experiments.

Monthly injections of thyroxine, given in three successive doses of 10 to 15 mg. daily, have been found to give an increase of 10 to 20 percent in milk

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yield. The maximum increase is usually attained within five to six days following the beginning of thyroxine administration. Milk secretion continues at an elevated level for 10 to 12 days following the treatment and gradually returns to the pre-injection level. The fat percentage has increased rather markedly with a slight increase in solids-not-fats. Cows in the early decline of lactation appear to give the most pronounced increase in yield.

Preliminary work with whole anterior pituitary extracts demonstrates that large doses are necessary to obtain an increase in milk yield. However, the size of the dose varies considerably with different cows and with the stage of lactation. Cows in the early stages of lactation have shown indications of making the greatest increase in yield following treatment.

The work at present has not progressed to the extent of permitting definite conclusions as to the maximum response obtained by uniform dosages of these hormone substances administered at the various stages of lactation.

P29. Vitamin C Metabolism in the Dairy Cow. W. H. RIDDELL AND C. H. WHITNAH, Kansas Agricultural Experiment Station.

It has previously been reported from this station that the change from winter feeding to spring pasture did not increase the vitamin C content of milk. What effect then has the increased intake of vitamin C on the vitamin C metabolism of the dairy cow?

The following effects were noted in three cows which were changed from a winter ration to all the green rye they would consume.

1. The vitamin C intake increased regularly for ten days to a maximum of over sixty grams per day.
2. The average vitamin C content of the blood more than doubled within twelve hours after the green feed was first supplied. The blood level reverted to normal within the next twelve hours.
3. The average output of vitamin C in the urine was increased over five-fold within sixty hours after green feed was first supplied.

The fate of vitamin C was studied in the rumen contents of a cow with a rumen fistula, and in a steer at slaughter. In each case the rumen contents contained less than one-tenth the vitamin C of grass ingested twelve hours earlier. The solid and liquid portions of any sample of the rumen contents contained equal concentration of vitamin C.

The early rise of vitamin C in blood and urine, and its rapid disappearance from the rumen, suggest that the vitamin was rapidly absorbed. The first two of these changes also suggest that an ample supply was available even to cows on winter feed. The return of blood to normal levels, the failure of urinary output to continue increasing, and the failure of vitamin C output in milk to increase, all indicate that the increased intake may have been compensated for either by decreased synthesis or by increased destruction.

P30. Fat Metabolism of the Mammary Gland. J. C. SHAW AND W. E. PETERSEN, University of Minnesota.

Blood fat arterio-venous differences were determined in numerous experiments. There was a consistent and comparatively large loss in blood fat as determined by Allen's (1934) method. The arterio-venous fat loss did not show any relationship to either arterial blood fat level or quantity of milk secreted. However, the arterio-venous fat differences increased with the increase in period of time following milking.

The arterio-venous fat loss was sufficient to account for all of the fat in the milk as shown by the relation of fat arterio-venous differences to the arterio-venous loss of calcium, and the combined loss of glucose and lactic acid, when it is postulated that some of the fat is used as a source of energy for the gland by oxidation, which in turn will account for the lower fatty acids found in milk fat.

P31. Enzymatic Relationship to the Synthesis of Milk Fat. PHILIP L. KELLY, University of Arkansas.

A previous study indicated the presence of sufficiently large amounts of free fatty acids in the bovine mammary gland to suggest that they played a significant part in the actual processes of milk fat secretion. It was thought that their presence might come about by the action of enzymes on the blood fat constituents, and a study was made to determine this point.

Three glands were used in the study. Samples of tissue from each gland were heated in a water bath to over 75 degrees C. for the purpose of stopping enzyme action. These samples served as controls. These and additional samples which were not heated were mixed with portions of ethyl-butyrate and toluene, and allowed to stand at room temperature for a period of not less than five days. They were dried with calcium sulphate and extracted with ethyl ether. The concentrated extract was made up to volume with petroleum ether, and the acid value was calculated from aliquots of this material in each determination. Each analysis was made in duplicate. The necessary blank analysis was determined in each case.

The following table gives the acid values of the mammary gland fat under the various conditions of the experiment.

Gland number	Condition of the gland	Acid value fat of fresh tissue	Acid value fat of heated tissue	Acid value fat of unheated tissue
1.	Lactating	34.0	38.5	88.2
2.	Lactating	39.7	54.5	90.5
3.	Non-lactating	17.4	26.4	154.1

In each instance there were very marked differences in acid value between the samples of heated and unheated tissue. The evidence obtained indicates

that enzyme action may be responsible for the presence of free fatty acid in the secretory tissue of the bovine mammary gland.

P32. The Effect of Fasting and Refeeding on Milk Secretion in the Cow and Goat. L. E. WASHBURN, Department of Dairy Husbandry, University of Missouri, Columbia, Missouri.*

Data on yield of milk and percentage of milk constituents indicate a remarkable persistency to maintain lactation during fasting in the cow and goat. Certain data also show that fasting may have a beneficial effect on later milk secretion. While levels of fasting energy metabolism are approached at the same rate in these animals, declines in milk secretion proceed at different rates. At 72 hours after feed, in the cow, milk yield has declined 50% and fat percentage has increased 100%; in the goat, milk yield has declined 80% and fat percentage has increased about 400%. Milk yield and percentages of constituents return rapidly to original pre-fast values upon refeeding.

P33. The Course of Fasting Energy Production Curves in the Lactating and Dry Dairy Cow Under Similar Environmental Conditions. L. E. WASHBURN, University of Missouri.†

Preliminary studies indicate that, under similar conditions of treatment and environment, the fasting energy production of a lactating dairy cow is of the order of 10% higher than that of the dry cow. This difference is quite constant until about 60 hours after feeding. The heat production of both cows declines 47%, and reaches a level at 36–48 hours after feed. While this level is maintained by the dry animal, the heat production of the lactating animal further declines about 16% after 60 hours. Milk yield decreases about 50% during 72 hours of inanition, but the fat production remains at a remarkably constant level.

These studies seem to show that in the dairy cow (1) lactation as a function is maintained within certain limits of inanition; and, (2) the higher energy metabolism of the lactating animal is due in a large measure to specific dynamic effect of the food. It is believed that lactation stimulus, endocrine or otherwise, acts to a considerable degree upon the alimentary system of the animal.

P34. Nature of Swelling in the Cow's Udder at Calving Time. W. W. SWEET, C. A. MATTHEWS AND R. R. GRAVES, Bureau of Dairy Industry, U. S. Department of Agriculture.

Opinions differ as to the extent to which the intensity of swelling in the udder at parturition interferes with the normal functions of the mammary

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glands and with maximum milk secretion. Recently a cow was slaughtered soon after she had calved, when her udder was in an extremely swollen condition with the cool, plastic kind of swelling in which pressure with the finger tip leaves a persistent indentation. The cow was a slow, hard milker. She produced as much as 74 pounds of milk in one day and a total of 520 pounds of butterfat for the year as a 4-year old. A pronounced udder swelling accompanied by marked abdominal swelling occurred at each of her four calvings. At the fourth parturition the size of the udder reached extreme proportions.

Although the udder was milked out immediately before the cow was killed, the amputated udder weighed 165 pounds. The fluid-holding capacity of the udder was 111 pounds. An incision between the right and left halves showed a layer of swelling about 2 inches thick between the skin and the glandular tissue. The surfaces exposed by the incision indicated that the material making up the swelling consisted chiefly of a clear fluid in which there was a network of fine silky fibers, glistening in appearance, and resembling spider's web. The fluid was tenaciously held and did not escape. The swelling obviously was edematous in character. Histological studies indicated that the swollen material contained an interwoven mass of fibers, and that the swelling did not invade the adjacent glandular tissue to any appreciable extent. All four quarters of the udder were functioning at the time of slaughter and aside from the edematous swelling there was nothing to indicate any significant abnormality.

P35. Some Factors Affecting the Resistance of Animals to Mastitis.

LLOYD A. BURKEY, EDWARD B. MEIGS, GEORGE P. SANDERS AND MORRISON ROGOSA, Bureau of Dairy Industry, U. S. D. A.

A study was made of the number of leucocytes present in the milk, the germicidal property of the milk and the inhibitory action of bovine blood serum against *Streptococcus mastiditis* in an effort to evaluate these agents as natural resistance factors against mastitis.

Results obtained show that large numbers of leucocytes in milk indicate an injury to the udder, but not necessarily the presence of an infection. Leucocytes appear to act as effective agents against infection in some cows, while in others infection is delayed for a number of months or until a general breakdown in animal resistance takes place.

The germicidal property of the milk differs in individual cows and in the different quarters of the same cow. There is also a tendency for this property of milk to increase with the increase in the severity of the disease and with the increased numbers of leucocytes until the acute stage of mastitis is reached. After this point the milk contains less germicidal substance.

Bovine blood serum contains a factor inhibitory to the growth of *Streptococcus mastiditis* in milk of the same cow in vitro. This factor is ineffective

after the serum is 4 or 5 days old and when added to milk from a cow other than the one providing the serum. The inhibitory power of blood serum decreases rapidly with increased symptoms of mastitis and appears to be intimately related to animal resistance. Blood serum lacking in this inhibitory factor acts as a medium and therefore enhances the growth of *S. mastiditis* in vitro. The combined action of the germicidal property of the milk and the inhibitory factor of the blood serum produces a greater retardation of growth of *S. mastiditis* in vitro than is produced by each separately.

The extent to which these inhibitory factors in vitro are identical in their action in the udder and just how significant they may be as factors in the resistance of the animal to the invasion and growth of *S. mastiditis* permits considerable speculation. It is possible that an injury resulting in the increase of chlorides in the milk may at the same time bring about an inflow of blood serum in the udder. It is conceivable under such a situation, which may be quite common, that this effect would result in either a protection against infection or more favorable conditions for growth of *S. mastiditis* in the udder. Results obtained, when milking machines were used at high vacuum, showed an increase in the percentage of chlorides in the milk and an increase in the incidence of mastitis.

Results obtained in the study of these factors indicate that they may be significant defense agencies against infection. Further studies are needed to determine the manner in which these animal defenses may be fortified by animal management to make them more effective safeguards against infection.

P36. Preventing Sudan Grass Poisoning. FREDERICK BOYD, O. S. AAMODT, G. BOHSTEDT AND E. TRUOG, University of Wisconsin.

During the past year a method for determining the amount of prussic acid present in plant tissues has been developed which is simple, fairly rapid, and is believed to be considerably more reliable than some of the other methods which have been proposed. This method may be referred to as a "chloroform-steam distillation-picrate colorimetric" procedure. By this test several hundred farmers' samples of sudan grass have been analysed for prussic acid during the past year, together with great many samples from experimental plots.

The findings are as follows: Short, dark green sudan grass is at times so high in prussic acid, or hydrocyanic acid, as to be dangerous to pasture. Second growth after pasturing or removal of a hay crop when short and dark green is especially dangerous. Sudan grass which is 1½ feet or more in height is usually low in hydrocyanic acid and is relatively safe to pasture. Sudan grass, short or tall, which is of a pale or yellowish green color is low in cyanide poison and is relatively safe to pasture.

A high level of available nitrogen and a low level of available phosphorus in the soil tend to increase the poison content in plants, while a low level of available nitrogen and a high level of available phosphorus have the opposite effect. A high cyanide content may, however, still occur in short plants, especially in the second growth, even though the level of available phosphorus is high.

Drought probably operates as a factor, largely, by keeping the plants small in which stage they are always much higher in cyanide than when larger.

When sudan grass is dried and made into hay, the cyanide poison content does not change greatly. Since it is usually not cut for hay until it reaches a height of three feet or more, there should be little if any danger from cyanide poison in sudan grass hay.

Cattle when turned into sudan grass of high poison content usually stop eating after about 15 minutes, due to the action of the poison. If the animals are not too hungry and are in a high state of vigor, they usually stop eating before they take a fatal dose. If they are in a low state of vigor and very hungry, they are more apt to eat a fatal dose.

For this reason it is important that cattle be given some other feed previous to turning them into a sudan grass pasture, when this is done for the first time during a pasture season. As an added precaution, it is a good plan to watch the herd for an hour on being turned into a field of sudan grass. If some of the animals stop eating sudan grass after a few minutes, or look around for other grass to eat, it is a good sign that the sudan grass is dangerous.

P37. A Report of the Occurrence of Four Cases of Agnathia. FORDYCE ELY, H. B. MORRISON AND F. E. HULL, Kentucky Agricultural Experiment Station.

Agnathia or an agnathic condition, according to Webster, describes a case where the jaw is absent or deformed. During the past two years three male calves have appeared in the Kentucky Agricultural Experiment Station herd, and one in a related herd, whose lower jaw and tongue anterior to first premolar are entirely lacking. The calves in the Experiment Station herd were all by the same sire and also closely related through their dams. A genetic analysis is presented showing relationship coefficient between afflicted calves according to formula of Lush.

One of the calves was carried for a normal gestation period, another was discovered in the uterus of a cow slaughtered in another experiment; a third calf was discovered as an aborted fetus from a Bang's disease negative heifer. A fourth agnathic male calf has come to the attention of the authors in a Western Kentucky breeder's herd. The sire was from the Experiment Station herd and the afflicted calf carries a concentration of the same blood as the first mentioned calves.

Other anatomical data on three of the calves are presented. The heads and hearts show identical abnormalities which are described in some detail.

P38. Maximum Initial Yield and Persistency as Inherited Characters Influencing Total Lactation Yield. LESTER O. GILMORE, WM. E. PETERSEN AND J. B. FITCH, University of Minnesota.

A review of the literature reveals that there are almost as many opinions against the idea that inheritance affects persistency and initial maximum yield as there are opinions and data in support of it. The data represented in this report were taken from a study of the generally considered influences on persistency. They are presented here because they represent a different type of analysis and because they seem conclusive.

The data were taken from the records of the University herd and from a cow testing association. The former herd is managed under a standard plan, adopted in 1923, in which it is aimed to provide as standard an environment as possible in regard to age of calving, lactation during which cow is on official test, duration of test period, frequency of milking and ration utilized. The C. T. A. records all came from a herd larger than the average in which conditions of good management were known to prevail and in which the usual exigencies of poor crop yields were minimized.

In the analyses there was a breakdown of the data, first according to breeds and secondly according to the sires within the breed. Thirdly, for sires having a relatively large number of daughters, the production of the daughters was grouped according to the sire of the dams of these daughters.

With three-time-a-day milking one group of daughters averaged 19 per cent more milk in a year than did the daughters of another bull. Both groups started out at approximately the same initial yield, the difference consequently being ascribed to the difference in persistency that resulted. One group of a sire's daughters averaged 32 per cent more milk a year than did another group of the same sire's daughters, the grouping being made according to the sires of the daughter's dams. The persistency was similar in the two groups but there was a marked difference in the initial maximum yield. The significance of this difference is increased by the fact that one group of these dams was purchased and the differences between this group of daughters and each of the other groups are consistent. It is known that selection in the herd from which these purchases originated was not based primarily upon production. The smaller differences in initial yield of daughters from cows developed in the University herd show some of the effects of selection of sires over a long period, on the basis of their daughters' production. The graphs presented indicate that hereditary factors affecting initial maximum yield and persistency are inherited independently.

P39. Herd Averages Computed by the Cow-Year Method Versus Herd Averages Based Only on Cows on Test at Least 10 Months. JAY L. LUSH AND FLOYD JOHNSTON, Iowa State College.

A survey of Iowa C. T. A. Herds including 114 herd years indicates:

1. Cows entering the herd during the year average more on the cow-year basis than do cows which are in the herd all year. (Presumably their age handicap is more than offset by the absence of dry period and by the fact that it tends to be the flush part of their lactation which is included. Probably the records are higher than the real abilities of the cows.)

2. Cows leaving the herd during the year average less on the cow-year basis than do cows which are in the herd all year. (Presumably some of these have been sick and many have been in the later stages of their lactations. The records are probably poorer than the cow's real abilities.)

3. Cows on test between 10 and 12 months of course average more on the cow-year basis than they do if each such cow is counted as a unit in computing the average.

4. The bias from 1 almost exactly cancels that from 2 when large numbers are involved but of course will not always do that in individual herds.

5. Only about 60 to 70 percent of the total number of cows in the herd at some time or other during the year are in it for more than 10 months of that year. A herd average based only on those cows which were on test at least 10 months will sometimes be erratic because of the small number of animals included.

6. Which method will most accurately indicate the average genetic ability of the herd depends mainly on whether in individual herds the errors from 5 are usually larger than the errors from 1 failing to balance 2.

P40. Age and its Influence on Culling and Life Expectancy in Dairy Cows. D. M. Seath, Kansas State College, and J. L. Lush, Iowa State College.

In a study of 147 Iowa cow testing association herds for the years 1931 to 1935 inclusive, it was found that an average of 29 per cent of the cows left these herds each year. This included cows leaving for all reasons, *i.e.*, disease, low production, injury, death, dairy purposes, *et cetera*. In classifying the cows for a particular year, those remaining in the herd for the entire year following were called non-culls, while those leaving before the completion of the following year were classified as culls.

Of the cows under eight years of age, the two and three year olds were culled most severely with 28 and 31 per cent respectively of these leaving the herds each year. Only 23, 25, 27, and 26 per cent left the four, five, six, and seven year old groups. Those eight or more years of age showed an increase in percentage culled ranging from 32 to 100 per cent.

The spread between the production of the non-culls and culls was compared for the various age groups in order to obtain evidence of when the most culling took place. When considered on this basis culling for production among younger cows was the most pronounced for the three year olds who

showed a spread between culls and non-culls of 75 pounds of butterfat. The two year olds had a difference of 63 pounds, while those from four to twelve years of age had a narrower spread, ranging from 32 to 60 pounds of butterfat. The milk production differences between the groups showed a similar trend.

Life expectancy estimates in terms of time cows will stay in C.T.A. herds have been computed for cows from two to seventeen years of age inclusive. In their computation, the number of animals falling into the various age groups at the beginning of each cow testing association year was used. The number present for a given age compared to the total cows represented in older groups was used as a basis for estimating their life expectancy. The data for the five years were combined to smooth out irregularities noted for individual years. In the resulting table the three year olds had the longest life expectancy in herds. The four, five, and two year old groups followed in order named. A rather slow decline was noted in the life expectancy up to nine years of age, with a rapid decline thereafter.

P41. The Breeding Efficiency of Proved (Aged) Sires. J. R. DAWSON, Bureau of Dairy Industry, U. S. Department of Agriculture.

A study was made of the breeding efficiency of 20 proved sires used in eight branch experiment station herds maintained by the Bureau of Dairy Industry. The sires included 8 Jerseys, 2 Guernseys, and 10 Holsteins, and only services and conceptions after the sires were 5 years of age were included.

Fertility is expressed by the percentage of the services to fertile cows that resulted in conceptions. The effect of extra services and services to unfertile cows is considered separately. A total of 3,585 services were included in the study, of which 2,982 were to fertile cows. The data were tabulated and analyzed from the standpoint of (1) the relative fertility of the individual sires, (2) the effect of advancing age on fertility, (3) the effect of frequency of service on fertility, (4) the effect of season of the year and climatic conditions on fertility, and (5) the effect of moving sires on fertility.

Seventeen of the 20 sires averaged 4 years and 5 months of fertile service in the herds after they were 5 years old. The shortest period of fertile service was 1 year and 7 months, while the longest period of fertile service was 11 years and 1 month.

Forty per cent of the 2,982 services to fertile cows resulted in 1,197 conceptions, which is a ratio of 2.49 services.

Great variation in fertility was exhibited by individual sires as evidenced by a low fertility of 21 per cent by one sire and a high fertility of 71 per cent by another sire.

There was a decided but inconsistent decline in fertility of the sires as age advanced. At 5 to 7 years of age, the average fertility of the sires was

52 per cent and at 13 years of age or over it was 28 per cent. There was wide variation between individual sires.

On the average there was a decided trend toward lower fertility as the number of services per month increased, but the effect of the frequency of service in one month was most pronounced in the following month. When no services per month were permitted, the average fertility was 47 per cent the following month. When from 1 to 3 services per month were permitted the fertility for the following month dropped to 45 per cent, with a further consistent decline to 30 per cent when 10 or more services were permitted for the preceding month.

Season of the year apparently had little if any effect on fertility. Grouping the data from the standpoint of climatic conditions showed that the fertility was only 36 per cent for the sires used at the southern stations, whereas it was 49 per cent for the sires used at the western and northern stations.

Seventeen of the 20 sires averaged 41 per cent in fertility during the first 3 months following shipment to their respective stations and only 32 per cent after they had been at the stations 10 to 12 months. There was a general increase in average fertility until it reached a high of 47 per cent after 19 to 21 months at the station.

Because of the extreme and inconsistent variation in fertility exhibited by the individual sires on all phases included in this study, it is apparent that averages are of little value for application to individual sires.

P42. **Twelve Years with 1200 Cows.** J. D. Bragg, Agricultural Supervisor, Department of Public Welfare, State of Ohio.

The Ohio Department of Public Welfare has the problems of housing, feeding, and clothing 36,000 state wards. These people must be guided morally and mentally while under its care in the twenty-three state institutions. Occupational therapy now furnishes numerous advantages to those who necessarily must be placed in the confines of the Ohio Welfare Institutions. The Welfare Department owns approximately 20,000 acres of land and cultivates about 12,000 acres in conjunction with the institutions. The dairy cow has become increasingly important to the members of the welfare family. She furnishes interesting and productive employment and a variety of wholesome and nutritious foods. The farming program is adjusted as nearly as possible to the needs of the dairy herds.

Twenty-seven hundred head of Holstein cattle located on sixteen farms furnish the bulk of the dairy products consumed and reproduce in surplus all of the heifers and bulls for replacements and for new herds. They give to those who care for them the pleasing task of working with something alive. These cattle have been responsive to kind treatment, careful feeding, selective breeding, sanitary housing, and sound health practices. As evidence, the herd average of more than twelve hundred cows has increased 49% in the last twelve years.

P43. Artificial Insemination of Dairy Cattle. C. L. COLE, University of Minnesota.

This experiment is being conducted in an attempt to test the practicability of artificial insemination in dairy herds under ordinary farm conditions.

The bull is kept at the North Central Station of the University of Minnesota and cows located from one to ten miles distant and in seven different herds are being artificially inseminated.

One herd of eighteen cows has had a very low breeding efficiency for the past several years and shows a rather low percentage for artificial insemination. It is, however, no lower than in previous years with natural breeding.

Another herd of twenty-three cows in which there has been continued trouble for several years with Bang's disease shows a very good breeding efficiency although it is impossible to make any comparison of records due to the 100% turnover of individuals during the past two years.

A third herd of forty that is disease free and on which complete breeding records have been kept for several years show a breeding efficiency considerably higher with artificial insemination than the preceding five year average.

The balance of the cows are located in small herds and their breeding histories are not available.

Sperm samples are collected by massaging the ampullae.

All the cows have been inseminated with fresh samples. The maximum age of any sperm used has not exceeded five hours.

The inseminating pipette is a glass tube about seventeen inches long, $\frac{1}{4}$ inch outside diameter with a 1/16 inch bore. This is welded at right angles to a tube about five inches long with a 3/16 inch bore. It is advantageous to have a pocket blown in this piece to serve as a receptacle for the semen. A pyrex glass speculum $1\frac{1}{4}$ inches in diameter and fourteen inches long and a flashlight complete the equipment.

The speculum is used to locate the cervix and a small quantity of semen is placed in the opening.

From available data, it seems that cows are best bred at the end of oestrum. We have made an effect to inseminate the majority at that time. Many of them have been inseminated from six to twenty-four hours after the passing oestrum with equally good results. Our data seems to indicate that better results will be obtained when cows are bred shortly after passing off heat than when bred at the first signs. Our data is not, however, complete or conclusive.

Three cows that had been both bred and inseminated several times and had failed to conceive were finally settled when small corpora lutea were removed from their ovaries during one oestrum and bred on the following oestrum. Another cow after failing to conceive was finally settled by rupturing the follicle mechanically and then inseminating her.

Extremely cold weather offers some obstacle since sudden chilling has a deleterious effect on the sperm.

Results seem to indicate that breeding efficiency can be maintained and often times improved by artificial insemination and that this method of breeding may offer an excellent opportunity to prove sires and greatly extend the use of already proven sires.

P44. Relation Between Rate of Growth and Milk and Fat Production.

H. P. DAVIS AND E. L. WILLETT, University of Nebraska.

There is an urgent need of means of predicting producing ability in dairy cows before a lactation has been completed. Prentice, in unpublished data, has indicated a correlation between feed consumption of calves and subsequent milk and fat production. Turner, in unpublished data, has hinted at a close correlation between pituitary activity and production. Seventy-six closely related Holstein femals from the University of Nebraska herd were studied in rgard to their rate of growth between birth and two years as correlated with their subsequent milk and fat production for the first and for their lifetime average of lactations corrected to 365 days, class B, maturity. The three measurements were weight, height at withers, and chest girth. The 76 females were compared to the standards established at the University of Nebraska and found to compare closely with them.

The group of 76 females were arranged according to percentage of increase in weight at two years over birth, in groups with 50 per cent class intervals, varying from 900–949.9 to 1750–1799.99, with an average of 1220.6 This latter figure represents the relationship between 87 pounds at birth and 1149 pounds at two years of age. The subsequent production for the first and lifetime lactations of each group is presented in a table. The same animals were arranged according to percentage increase in height at withers by two percent class intervals and ranged from 70–71.9 to 100–101.9 with production for these gains shown on the table. The same animals were also arranged according to percentage increase in chest girth by four per cent class intervals, ranging from 120–123.9 to 172–175.9.

Seventy-six Holstein femals of the University of Nebraska herd, apparently normal according to standards established there, when their milk and fat records for the first and for the average of their lifetime lactations were arranged in tables according to the percentage rate of gain in weight, percentage increase in height at withers and percentage increase in chest girth, showed no significant relationship between rate of growth and production.

EXTENSION SECTION

E1. Methods of Presenting Different Extension Practices in the Testing Project. GLEN W. VERGERONT, Wisconsin College of Agriculture.

I. THE PROBLEM. LET US TAKE INVENTORY.
- A. Our project meets with considerable competition with others for the time of the county agricultural agent.
- B. Too many dairy herds have a level of production far below the line of profit.
  1. A study of butterfat sales by one county agent indicated a variety of incomes from dairy products at the same milk plants.
  2. THE COUNTY AGENT became interested in herd improvement.
- C. Methods used to interest his dairymen.
  1. A comparison of the average fat production per cow of the county, the state and the nation.
  2. New D.H.I. Association members were encouraged to estimate production expected from each cow in herd.
  3. Reasons for low producing herds.
- D. COUNTY-WIDE PLANS for dairy herd improvement.
  1. Plan to increase the net income for the dairy farmer.
  2. D.H.I.A. testing is a good dairy farm management practice.

II. Promotion.
- A. General publicity arousing a desire for herd improvement.
- B. Newspaper publicity prepared in cooperation with college agricultural journalism department.
- C. Schools.
  1. Breeding schools put on by the college men.
  2. Assistance at schools put on by breed associations.
- D. Tours, Cattle Exhibits, Picnics, 4H demonstration and judging contests.

III. Maintenance. The responsibility for maintenance for associations rests with the extension dairymen and the county agricultural agent.

IV. SUPERVISION AND INSPECTION.
- A. Farm visits to officers and members.
- B. Inspection and assistance to fieldman.
- C. District conferences.

E3. An Extension Program Coordinating Dairying, Crops, Farm Engineering, Farm Management and Forestry. A. R. MERRILL, Connecticut State College.

An Extension program must be practical for the section where it is to be

used. The reasons for this program must be sound and the results obtained must tend towards making for a stabilized agriculture.

The day of individual program making is past. No one specialist is important unto himself alone. No Extension program should be put out until it has had careful study by all specialists who may in any way be associated with its development. Individual subject matter should be handled only by the specialist who is directly informed on that subject, but all subject matter should fit into the general plan and be sound in practice.

Such studies will result in better programs and will educate both specialist and farmer toward a more uniform understanding of our extension problems.

E4. A Method Used to Illustrate the Fact that Higher Producing Cows Make Larger Returns for Roughages. W. T. CRANDALL, Cornell University.

Some farms are best adapted to the growing of roughage crops for which there is normally no satisfactory direct cash market. Dairy cows are kept on many of these farms as a means of marketing these unsalable farm crops and returning cash for them. It is just as important for dairy farmers to be interested in keeping good cows that will pay well for the home grown feed, as it is for them to sell their milk to a satisfactory market.

In order to emphasize the relation of better producing cows to higher returns for roughages, any sufficiently large number of cows with dairy herd improvement association records is divided into four groups. The division is made on the basis of yearly butterfat production and the range of selection is as follows: Under 250 pounds, 250–349 pounds, 350–449 pounds, over 449 pounds. A chart that is built up step by step during the progress of a lecture is used to show for each group the gross income, the costs of production other than for feed, the cost of grain and the amount remaining to pay for the pasture, silage and hay consumed. In the final addition to the build-up chart the amounts returned by the various groups for each ton of hay equivalent consumed (hay plus $\frac{1}{3}$ silage) is shown. It is possible to make up this kind of material when complete yearly feed and production records are available on as few as 400 cows.

A discussion of the results obtained from a recent study of the records of 436 full time cows in one New York dairy herd improvement association will indicate the type of material that can be presented by this method. The average yearly butterfat production in pounds of each group was 210, 296, 387 and 477 respectively. The calculated costs other than feed, the grain cost and the charge for pasture were deducted from the gross income of each group and amount remaining was credited to the hay and silage consumed. The 210 pound group was credited with nothing for hay and silage, the 296 pound group with $42, the 387 pound group with $60 and the 477 pound group with $82. On the basis of hay equivalent actually consumed the

groups paid the following amounts per ton: the 210 pound group, $0.00; the 296 pound group, $12.03; the 387 pound group, $18.50; the 477 pound group, $24.00.

E5. An Extension Program in Grassland Farming. C. B. Bender, N. J. Agricultural Experiment Station.

The interest in a program of this type is stimulated by the same methods that are used to sell many other extension programs.

As this program includes both intensive pasture management and molasses grass silage as fundamental parts, the attack will vary with the season of the year. It is not necessary to start the program at any particular time of the year, the only essential is that the leader of the program should be enthusiastic about it because of the end results.

If the program is to be initiated on a state wide basis in the winter, meetings should be held in the various dairy centers of the state. At this time through talks and lantern slides the methods of carrying out the work, experimental results and economic experiences are brought out.

If any dairymen in the state have put up grass silage, barn meetings may be held at their farms at which time the leader of the project can discuss methods and objectives of the program and the dairyman can furnish his own experiences showing the practical feeding results he has obtained.

These meetings are followed up by news stories in the local and state press, circular letters sent out by the county agents and farm journal articles bringing experimental facts to light and submitting results that have been accomplished on dairy farms within the state.

In the spring and summer months field meetings should be held on pastures to explain this method of grassland management. Again it is extremely advisable to have the owner give the results he has obtained by following this program.

Barn and field meetings should be held while the silos are being filled with molasses grass silage. The dairymen may then have an opportunity to study the harvesting methods and the methods of adding the preservative. At this time yield and cost data may be stressed to give comparisons with corn silage. Furthermore comparative acre yields of protein should be stressed between legumes, grasses and corn. Increased use of silos as well as silo capacity figures are of value at these meetings.

The fact should be stressed at every opportunity that this is a program of erosion control which can be carried out by a farmer without embracing contour farming or strip farming methods. Molasses preservation of legumes and grasses is excellent crop insurance because it eliminates the hay making losses due to inclement weather. The method provides a better labor distribution and any dairy farmer who has a silo, silage and hay machinery can carry out the program successfully and with sound feeding economy.

E6. A Method for Preventing Onion Flavor in Milk. C. E. WYLIE, University of Tennessee.

For over 150 years wild garlic or wild onions have gradually spread from the Atlantic coast to all sections of the country. While it affects several agricultural products it is becoming a serious menace to dairying in certain sections. It affects the milk and it is crowding out good pasture grasses. The methods which have been recognized for control of the onion problem are as follows: (1) Cultural methods, (2) Feeding methods, and (3) Removal of the flavor from milk or cream. Each of these methods has its peculiar advantages and adaptability.

PREVENTION BY MOWING PASTURES

It has been found that allyl sulphide in the onion tops is the cause of the onion flavor in milk. This unites with the butterfat. It is a volatile substance which passes off in the air when the tops are cut. The onions grow readily early in the spring ahead of other vegetation because a temperature of 30°–50° F. is favorable for their growth. The tops stop growing late in the spring.

In order to determine when to cut the tops, small plots, about eight feet square, are marked off for trial cuttings. A hoe is used to cut off the tops. If, on examination, a few days later, no new onions have come up it is time to mow the entire pasture with a mowing machine. When the onions are wilted, by the second day, cows may be pastured on such pasture for the summer season. This method is not satisfactory for handling the crop of onions which come up in the fall. Neither will this method eradicate the onion plant. This method of mowing pastures has been successfully used for more than ten years at the University of Tennessee in a pasture badly infested with onions.

E7. The Use of Electric Fence in Bull Pen Construction. JAS. W. LINN.

The customary bull pen is not adequate for the average breeder or dairyman.

In bull pen construction, the electric fence has its main value as a supplement to other fences and when properly installed with an efficient transformer, is safe and effective.

E8. Dairy Cattle Breeding Schools. E. E. HEIZER, Ohio State University.

The following outline presents subject matter covered in a two session breeding school. Film strips, motion pictures, charts and Herediscopes are utilized as methods of presentation.

FIRST SESSION

Principles of Heredity

(a) Biological Foundation.

The Cell—Ordinary cell division, formation of germ cells, control of sex.

(b) Theories of Inheritance.
Older Theories.
The contribution of Mendel.
One, two and three factor inheritance.
Multiple factor inheritance.

(c) Abnormal and lethal factors.

(d) Variation and Selection.

(e) Breeding Practices.
Crossbreeding, Outcrossing, Linebreeding and Inbreeding.

SECOND SESSION

The Requirements of a Constructive Breeding Program

1. Sound Health Program.
Only healthy, disease-free cows produce efficiently.
2. A Complete Testing Program.
Continuous testing of all cows in the herd.
(a) Importance of environmental influences on production.
3. Intelligent Use of Records.
(a) Cull inefficient cows.
(b) Measure hereditary constitution of sires and breeding cows.
(c) Interpretation of Proved Sire Records.
(d) "Nicking" or Heterosis demonstrated by sire analysis.
(e) Utilization of sires—cooperation, artificial breeding.
(f) Importance of life span on profitability of dairy cows.
(g) Cow Family Studies.
(h) Herd Analysis.
4. Young Sire Selection.
5. A Breeder's Ideal.

E13. Report of Quality Committee, Extension Section, American Dairy Science Association. C. J. BABCOCK, Chairman, Bureau of Dairy Industry, United States Department of Agriculture.

A questionnaire sent to each of the States and returned by 46 of them revealed the following: Approximately 15.2 percent of our dairy extension is related to quality-improvement work. If evenly distributed and based on properly outlined projects for improving the quality of milk and cream as delivered to the plant, this percentage would not be unduly out of proportion. However, at least one-half of this extension work deals with methods of manufacturing dairy products. This lowers the percentage of extension work related to farm conditions to less than 9 percent. Looking at it from another angle; the 46 States reporting had on an average 1.7 men

working on dairy production compared with not over 0.15 of a man reported as doing work related to sanitary milk production, a proportion better than 10 to 1 for production over quality. Although this ratio is entirely too low and does not balance the importance of quality and production, it is actually too favorable to quality improvement. The ratio is correct according to the figures given, but a study of the projects reported reveals a large percentage of time has been credited to quality improvement that has no direct relation to improving the quality of milk and cream as delivered to the plant.

The questionnaire plainly revealed that a great majority of our States do not have a well defined or well outlined project for improving the quality of milk and cream.

Many of the States measure the results of quality work by what may be termed hearsay evidence. They have no estabilshed base from which to measure results. Neither do they have definite means for such measurements. This is largely due, no doubt, to the fact that they do not have well defined programs.

If the extension service would assume the leadership in a quality-improvement project, it could easily obtain the cooperation of the various agencies within the State necessary for its success.

The new projects which are to be started during the next year are few in number and, as a whole, show but little promise of accomplishing definite results.

Although practically all of the States admitted that insufficient extension work was being done on quality improvement, practically nothing is being done by our extension services to remedy this condition.

E14. Progress Report of Quality Committee of Dairy Products of the Dairy Manufacturing Section of the American Dairy Science Association. W. H. E. REID, Missouri Agricultural Experiment Station.

The quality of milk and milk products from the consumers point of view has received more than usual study during the past three years. Interest in this study has been manifested by our experiment stations and the different phases of the commercial industry. This interest includes all divisions of the dairy industry, production and manufacturing.

Consideration has been given to projects applicable on dairy farms and in dairy manufacturing plants which have for their objective improvement of methods practiced and equipment used in producing milk and the manufacture of dairy products which include butter, cheese, ice cream, condensed milk, evaporated milk and dry skimmilk. These projects are broad in their scope so as to be applicable in all states where milk production is of primary importance.

It is obvious that the objectives of quality programs projected by production and manufacturing interests are quite alike and should be coordinated in order to effect maximum accomplishments. Progress should be greatly facilitated by acquiring a mutual understanding of programs of the different interests involved.

E15. Milk Schools as a Means of Improving the Milk Supply. J. A. NELSON, Montana State College.

Regular milk samples are collected by the milk inspector unbeknown to the producer. The samples are scored in accordance with the U.S.D.A. score card B.D.I. 64. A meeting of all the producers is called at which time the dairy extension specialist discusses the factors that make for a good milk. Samples with defects in flavor are used for demonstration and the possible remedies explained. The milk samples are listed according to quality and at the end of each meeting the producers are confidentially given their scores with the defects and possible causes explained. This method is used not only for market milk but also for milk which is to be manufactured into other dairy products.

E18. What We Can Learn from Denmark in the Use of Artificial Insemination. E. J. PERRY, New Jersey Agricultural College.

A close range study of cooperative artificial breeding in Denmark has revealed its success. During the past 21 months, 1,200 cows owned by 220 cooperating Danish farmers were inseminated by using the semen of two sires. The work is being done by a salaried veterinarian. His primary job is insemination. The balance of his time is divided between preconception treatment and examination for pregnancy both of which are performed when his regular duty brings him to the farm or neighborhood. The plan puts breeding on a scientific basis and is of particular value to the rank and file of dairy farmers who cannot afford to pay similar services individually. Every sample of semen is examined under the microscope before it is used. To date the artificial method in Denmark has required an average of 1.2 services per conception whereas the natural method has required 1.8 services, or a difference of 33⅓ per cent. Other recognized advantages are: 1. The blood of superior sires can be widely utilized at a very low cost per service. 2. Practically eliminates the spread of disease through service. 3. Eliminates the necessity of keeping and feeding a bull on each farm. 4. A large family of cattle is quickly established in a district.

The technique of collecting, preserving and using the semen should soon become fairly well standardized. The artificial vagina as a means of collection is in favor in Denmark, the British Isles, Holland, Russia. It is of particular advantage before bulls have reached an old age. By it the semen can be gathered quickly and probably in a little cleaner condition than by

other methods. Collection by massaging the accessory genital organs, the system developed in this country, is of particular advantage when using older bulls. While all bulls do not respond equally well to this method and the quantity of semen obtained is sometimes small, it nevertheless is proving fairly satisfactory in cases where the proper technique of massage has been learned. In large scale artificial breeding it is recommended that both of these systems of collection be mastered so that either can be practiced, as the circumstances require.

In a well organized artificial breeding project, which does not operate over too large a district, the yearly cost per cow should not exceed $5.00. This figure is hardly as high as the yearly cost of bull service per cow in well managed herds where complete data including feed, labor, depreciation, housing and other items are included.

MANUFACTURING SECTION

M1. Some Factors Affecting the Estimation of Fat in Milk by the Babcock Method. W. A. CALDWELL AND E. O. HERREID, Vermont Agricultural Experiment Station.

Several Vermont Dairy Plants have shown, according to their books, excessive losses of butterfat; that is they have been unable to account for the fat purchased when checked against the fat sold in milk and milk products. These so-called losses caused so much concern that plant managers brought this problem to the dairy department at the University of Vermont for assistance.

To determine the amount of fat unaccounted for, the losses in one plant were summarized by months over a period of four years. The years 1932, 1933, and 1934 showed a greater amount of fat unaccounted for during the first as compared to the last six months of each year. The same relationship existed in 1935 but the difference was small. In two small receiving stations handling only milk and cream, the intake was checked with the outgoing fat. At plant A on three consecutive days the fat unaccounted for was 5.10, 6.25 and 3.75 per cent respectively and at plant B the results showed a loss of 4.52 and 6.79 per cent on two consecutive days.

In view of the fact that difficulties were experienced in accounting for fat under conditions existing in these dairy plants, it was deemed advisable to approach this problem through a study of some of the factors that might affect the estimation of fat by the Babcock method. The factors studied were temperature of sampling milk, temperature of adding water, temperature of water bath, temperature and speed of centrifuge, and effect of reading the tests with glymol. Mojonnier fat determinations were made on the same samples.

Milk was sampled at temperatures of 40, 70, 100 and 140° F., and the results showed that within the extremes of 40 to 140° F., the test was decreased

by 0.08 per cent as the temperature was increased. Within a range of 40 to 100° F. the test was decreased by 0.04 per cent.

The influence of temperature of centrifuge was studied at 75, 140 and 180° F. and ten samples of milk averaged 4.21, 4.23 and 4.24 per cents respectively. With respect to speed, the centrifuge was operated at 850, 1050 and 1400 R. P. M. and the results averaged 3.94, 3.95 and 3.99 per cents respectively.

The temperatures of water bath studied were 100, 140 and 160° F. The average results were 4.33,.4.37 and 4.40 per cents respectively.

The last 980 tests made in the above experiments were read with and without glymol and the results showed that glymol reduced the average test by 0.165 per cent. Sixty samples of milk were tested in quadruplicate by the Babcock method and in duplicate by the Mojonnier method. The former were read from the bottom of the lower meniscus to the extreme top of the upper meniscus and by eliminating the upper meniscus with glymol. The average readings obtained were as follows: Mojonnier, 3.84 per cent; Babcock, read without glymol, 4.00 per cent and the Babcock read with glymol, 3.83 per cent.

All Babcock tests made in this study were run according to Vermont regulations and in addition a column-meter and a magnifying glass were used to read the tests to the nearest 0.05 and nearest 0.1 per cent. The results reported are for fresh milk.

M2. The Cause and Prevention of the Decrease in Fat Test of Composite Samples. R. F. HOLLAND, Cornell University.

It has been known since 1890 that the Babcock tests made on composite fall about 0.1 per cent below the average as determined by daily tests on fresh milk.

The decline in test is most rapid during the first few days of storage and is greater when the samples are stored in composite sample bottles than when pipetted and stored in Babcock test bottles. The decline in test takes place when either the Mojonnier or the Babcock method of fat estimation is used.

The factors responsible for faulty dispersion of the fat such as "oiling off," churning, and packing of fat globules contribute most to the decline.

Saponin prevents the decline in test and can be used in samples to be tested by either the Babcock or Mojonnier methods. Five-tenths of a gram is sufficient for a 250 ml. sample.

Saponin reduces the danger of churning samples when preparing them for the test, and permits dispersion of the fat without the necessity of heating the sample.

M3. A Study of the Resazurin Test as Applied to Cream. HERBERT JENKINS, New England Dairies, Inc., Boston, Mass.

Shortly after the publication of Ramsdell, Johnson and Evans' report on resazurin as an indicator of the sanitary condition of milk, experimental work was started in these laboratories to determine whether or not resazurin could be used for the same purpose with pasteurized cream.

The research program was threefold: first, to ascertain the proper concentration of resazurin dye to use; second, to set a standard on the basis of reduction time for good, fair, and poor quality cream; third, to find out of the resazurin test would be a more rapid indicator of the quality of cream than the Methylene Blue Test. More than four thousand samples of cream of varying quality were used in this study which covered an entire year. Comparisons were made with the following tests: resazurin, methylene blue, microscopic, standard plate, and acidity.

It was found that one-tenth of one cc of .05 per cent resazurin dye solution is the proper amount to use with ten cc of cream. Procedure is then the same as for the Methylene Blue Test. The cream-resazurin mixture is grey in color and reduction time is recorded when the grey turns to pink. Creams reducing in less than one hour were generally found to have poor keeping qualities and had bacteria counts above 300,000 per cc. Creams which did not reduce in less than two hours had bacteria counts below 100,000 per cc. If pasteurized cream did not reduce within three hours with the resazurin test, it could be relied upon to have good keeping quality and to have a low bacteria count. A two-hour incubation period with the resazurin test gives results comparable to five hours with the Methylene Blue Test. Cream which reduced resazurin in five to fifteen minutes takes from one to one and one-half hours to reduce methylene blue. Results indicate that the resazurin test is a practical test for determining the bacterial quality of pasteurized cream and is superior to the Methylene Blue Test in that results are obtained more rapidly.

M4. Studies of Lipase Action in Milk. VLADIMIR N. KRUKOVSKY AND B. L. HERRINGTON, Cornell University.

The extent of lipolysis of the fat in milk was determined by titrating the free fatty acids in butter-oil prepared from the milk. It was possible to show that lipolysis occurs in normal mixed milk between the time of milking and the time of delivery at the pasteurizing plant.

A study of the milk of individual cows indicated the presence of active lipase in practically all samples, though there is considerable individual variation.

A study of commercial pasteurized milk sold in the State of New York revealed much larger quantities of free fatty acids than are normally present in fresh milk.

By warming cold raw milk to approximately 30° C., and then cooling slowly, the subsequent rate of lipolysis was greatly increased.

Evidence was obtained showing that milk contains at least two lipases. One is very sensitive to formaldehyde. The other is quite resistant to it. The relative amounts of these two enzymes varies in different samples of milk.

M5. Observations on the Lipase Activity in Cow's Milk. J. C. PFEFFER, H. C. JACKSON AND K. G. WECKEL, University of Wisconsin.

This investigation deals with a study of the lipase activity of cow's milk. The method of Nair was employed in all experiments to determine the lipase activity.

The authors found that no direct correlation existed between milk of late lactation and lipase activity. A direct relationship, however, was found between the amount of milk produced and such activity. Less lipolytic activity was observed when the milkings were ten pounds or less than when the milkings exceeded fifteen pounds.

The lipase activity of the milk from an individual cow does not vary to any great extent from day to day.

A marked decrease in lipase activity of milk was observed when cows are taken from pasture and placed on dry feed. This decrease in activity is not permanent, as it returns to normal within two weeks. A similar decrease is observed when cows are changed from dry feed to pasture.

The lipolytic factor is carried in the serum of the milk. When milk is separated, greater lipolytic activity is observed in the skimmilk than in the cream. As the fat content of the cream is increased the lipolytic activity decreases.

An increase in temperature of the milk during separation causes a decrease of lipase activity of both the skimmilk and cream. A marked decrease occurs when the milk is separated at 120° F. The slime of the separator bowl is an excellent source of lipase and possesses approximately three times the lipolytic activity of the original milk. The decreased activity resulting from higher temperatures of separation is believed due to inhibition of the enzyme by heat. Since the inhibition is approximately the same in cream, skimmilk and separator slime, it appears the effect of higher temperatures of separation is due to inactivation rather than fractionation of the enzyme.

The increased activity of lipase after homogenization of raw milk is not due entirely to decrease in fat globule size. A very slight difference is observed when untreated milk is added to homogenized and unhomogenized substrates.

Salt has an inhibiting effect on the enzyme. Salted raw cream butter develops less acidity than raw unsalted butter.

M6. Detecting Milk that May Become Oxidized. GEORGE R. GREENBANK, Bureau of Dairy Industry, U. S. D. A.

A simple method of determining the susceptibility of milk to oxidized flavor has been developed. A small amount of copper sulfate is added to the milk and the increase in oxidation-reduction potential determined. Unusual increases in potential indicate samples that may become oxidized. From 3 to 6 hours are required to complete the test. On samples of known origin and treatment the test has been at least 90 per cent reliable.

M7. The Relation of Oxidation-Reduction Potential to Oxidized Flavor in Milk. GEORGE R. GREENBANK, Bureau of Dairy Industry, U. S. D. A.

A study was made of the nature of the oxidized flavor and its relation to the oxidation-reduction potential of the milk.

The conclusions are based on examination of more than 3,000 samples of milk from many cows.

Thermal inhibition of the flavor is shown to act through a lowering of the oxidation-reduction potential.

The effect of metallic contamination on the flavor is shown to vary with the metal and its physico-chemical state.

Inhibition of the flavor by a change from dry to green feed is paralleled by a decrease in oxidation-reduction potential and an increase in poising action.

Light may inhibit, promote, or have no effect on the development of the flavor, depending on contamination and intensity of irradiation.

A schematic equation is presented which indicates the nature of the oxidation. A theory in keeping with the observations made during this study is presented to describe the nature of the oxidation. The equation assumes a mild chemical oxidation.

Many isolated facts presented by other workers are explained by means of oxidation-reduction potential changes.

M8. A Study of the Relation of Titratable Acidity to Metal-Developed Oxidized Flavor in Milk. W. CARSON BROWN AND R. B. DUSTMAN, West Virginia Experiment Station.

At the West Virginia Experiment Station a study of the acidity of 220 individual samples of freshly drawn cow's milk has shown no apparent correlation between the natural acidity of the milk and its tendency to develop oxidized flavor when contaminated with copper. All experiments in which acidity was studied were carried out on pasteurized winter milk and the tendency to develop oxidized flavor was determined by the addition of 1.3 p.p.m. of copper added after pasteurization, followed by a three-day storage period of 35° to 40° F. The presence of oxidized flavor was determined by taste.

Anderson, Dowd, and Stuewer (1937) found that the titratable acidity of winter milk is higher than that of summer milk. Since this seasonal change occurs coincidental with the change of susceptibility of milk to oxidized flavor, it seemed possible that this condition may have been partially responsible for oxidized flavor. Anderson and his co-workers found an association between acidity and the tendency to develop oxidized flavor and that "milk of high acidity invariably developed an oxidized flavor upon pasteurization." However, at West Virginia, the analysis of the data obtained from 220 individual cows' samples did not show any difference in the apparent acidity of the milk from cows whose milks were susceptible to oxidized flavor and those whose milks were free from this defect.

Anderson and co-workers were able to eliminate oxidized flavor from a commercial milk supply by reducing the titratable acidity to 0.145 per cent. However, in the present study neutralization to 0.13 per cent titratable acidity, or in a small number of cases to 0.10 per cent, did not effect the development of the flavor.

No explanation is offered for the discrepancy in results which have occurred except that possibly the milk used by Anderson and his co-workers was subject to the development of oxidized flavor without copper contamination while the milk used in these trials would not develop oxidized flavor unless contaminated with copper. It is also possible that in their work, because of neutralization, the milk did not dissolve sufficient copper from the equipment to cause the flavor to develop. In all trials herein reported the copper was added after pasteurization in the form of a copper sulphate solution. In view of these facts it would have been desirable to have made several trials upon naturally susceptible milk, but during the past two years milk of this type has not been available, except in rare cases, in the University herd.

The results of these experiments indicate that metal-developed oxidized flavor is not related to the acidity of freshly drawn milk and that the standardization of the titratable acidity to 0.13 per cent does not decrease the tendency of oxidized flavor to develop.

M9. Studies on the Activated Flavor of Milk. J. C. Flake, H. C. Jackson and K. G. Weckel, University of Wisconsin.

The specific flavor defect which is sometimes apparent in over-irradiated commercial vitamin D milk, and known as activated flavor may best be described by the terms burnt protein or burnt feathers. The terms mushroom and sunshine flavor are sometimes used. The flavor is greatly intensified by heating the irradiated milk to 180° F. or higher.

Studies were instigated to determine the conditions under which the flavor develops and something of the chemical characteristics of the compound responsible for the flavor.

It was found that when milk was heated to temperatures above 150° to 160° F. and cooled, previous to irradiation, the resulting irradiated milk had a more intense flavor than when either raw or ordinary pasteurized milk was irradiated.

Attempts at altering the salt balance of the milk by addition of sodium citrate, di-sodium phosphate, calcium acetate, calcium chloride, calcium lactate, or di-basic calcium phosphate failed to increase or decrease the flavor intensity.

It was found possible to remove the activated flavor from milk by oxidation. The addition of a small amount of either hydrogen or calcium peroxide either before or after irradiation caused a marked decrease in intensity of flavor. It was possible to remove the flavor by adding two to three parts per million of copper to the irradiated milk followed by bubbling air through the milk either at room or higher temperature. The best results with this method were secured by holding the milk at 140–145° F. for 30 minutes and bubbling air through it during this interval. Oxidized flavor eventually developed in the milk given this second treatment, when it was cooled and held at 40° F., but only after 36 to 48 hours. However, irradiated milk whether given this treatment or handed normally shows no greater tendency for development of oxidized flavor than does normal milk.

The studies indicated that when irradiation and homogenization are both used in processing milk better results are secured if irradiation preceeds homogenization.

M10. Variation in the Composition of Milk and the Effect on Solids-not-Fat. H. A. HERMAN, University of Missouri.*

Variations in the fat and solids-not-fat content of milk are often the contributing factors for controversies, many times of legal nature, in the selling and buying of milk. In an effort to gain additional information concerning the extent and nature of these variations the milk produced by the Missouri Station herd is being analyzed daily for fat and total solids content. In addition the milk from 25 cows is being analyzed every other week for total nitrogen, lactose, and chlorides. The effects of feeding, stage of lactation, season and temperature, age of the cow, and under soundness on the composition of the milk are included as a part of this study.

The data gathered to date indicate that season or temperature, it being very difficult to separate these two factors under practical conditions, largely accounts for the decline in the solids-not-fat content of the milk produced during the summer months.

In the herd of 60 cows, made up of 49 percent Holsteins, 39 percent Jerseys, and 12 percent Guernseys, the solids-not-fat content of mixed herd milk

* Contribution from the Department of Dairy Husbandry, Missouri Agr. Exp. Sta., Journal Series No. 563.

for the past twelve months has been observed to range from 8.0 to 9.7 percent. During July, August, and September of 1937, however, the range was from 8.1 to 8.7 percent, with an average solids-not-fat value of 8.45 percent. The majority of samples were above the legal standard of 8.25 percent solids-not-fat, but during July and August in particular, nearly 50 percent of the samples gave readings below 8.5 percent, the standard set by some cities. The temperature during these two months was seldom above 95° F., and was hardly comparable to the drought years of 1934–35–36 when the mercury often reached 110° F. The cows were fed largely on hay, silage, and grain, with limited blue grass pasture.

Turning the cows on succulent barley pasture in April and May resulted in an increased milk yield, but so far as can be determined the solids-not-fat content of the milk was not affected, averaging 8.4 to 9.5 percent for this period. Analyses of the milk produced during the summer months, when the solids-not-fat was lowest, showed the lactose and totals nitrogen to be lower than previous, and the chloride content increased. During the fall and winter months the total nitrogen and lactose increased. The chloride content of the milk increased gradually throughout the lactation period.

The solids-not-fat content of the milk of individual cows was found to be high immediately following freshening, but to decline during the height of milk flow, and increase as lactation progresses. The lactose content of the milk decreased quite markedly near the end of lactation and the total nitrogen and chloride content increased. The increase in chloride content near the end of lactation is quite sharp and it seems apparent that the osmotic pressure of the milk is maintained at this period by the substitution of ionized chloride for lactose.

M11. Studies on the Mold Mycelia Content of Sour Cream Butter. J. ADAMS AND E. H. PARFITT, Purdue University.

Examinations have been made on commercial samples of butter manufactured between August 1 and April 1, using the technique suggested by Wildman for the examination of mold mycelia in butter. In addition, controlled samples have been prepared to determine factors influencing the amount of mycelia in butter.

A definite seasonal trend was found in the mycelia content of commercial butter, being highest during the summer months and lowest during the winter months. In a study involving 205 samples of commercial butter made during December and January, 99 per cent of the 103 samples which were graded as first grade had mycelia counts of less than 40 per cent positive fields, and 41.1 per cent of the 102 samples which were second grade had mycelia counts of less than 40 per cent positive fields.

The retention of mold mycelia in butter was found to vary from 30 to 60 per cent of the total mold content of the cream and such factors as wash-

ing, working of the butter, and pH of cream at the time of churning had no appreciable effect upon the amount of mold mycelia retained in the butter. Factors influencing the growth of mold in cream such as age, incubation temperature, amount of cream surface exposed to air, and agitation of cream during holding have been studied and found to affect mold mycelia count of the butter. A method has been developed using a fat solvent for determining the mold mycelia in cream.

M12. The Effect of Temperature Upon Score Value and Physical Structure of Butter. W. H. E. REID AND W. S. ARBUCKLE, University of Missouri.*

Recent studies reveal that temperature is an important factor influencing the flavor of various dairy products. Submerged flavors exist at lower serving temperatures of the product, while full pronounced flavors are manifested at high serving temperatures.

When samples of butter were scored at temperatures of 40, 50, 60 and 70 degrees Fahrenheit, those samples at 50 degrees Fahrenheit received .5 to 2.5 points lower flavor score than at other temperatures. This procedure serves as a means of determining the quality of the cream used, efficiency of plant methods and the treatment butter receives subsequent to manufacture. It was observed that as the temperature of the butter was increased, flavors that are normally submerged at lower temperatures become apparent. The flavor score of butter manufactured from high quality cream was enhanced as the temperatures were raised, whereas the flavor score of butter made from cream of a questionable quality declined with increased temperatures.

Graphs showing rise in temperature of cubes, quarter and one pound prints of butter exposed at 80 degrees Fahrenheit indicated rapid temperature increase in the cubes, while a much slower rise was shown in quarter and pound prints.

A comparison of the structure and body consistency of the butters at different temperatures is being made by the use of the microscope.

M13. Application of the Burri Smear Culture Technic to the Examination of Butter. H. F. LONG AND B. W. HAMMER, Iowa Agricultural Experiment Station.

The Burri smear culture technic can be used to examine butter by picking small portions with a platinum needle, and culturing each on the surface of a dry agar slope. After incubation the colonies on the slopes are counted and studied for colony types. The maximum number of colonies on a slope that can be counted readily is about 100 although larger numbers can often

* Contribution from the Department of Dairy Husbandry, Missouri Agr. Exp. Sta., Journal Series No. 556.

be estimated satisfactorily. Various media and incubation conditions can be used with the procedure. If a differential medium, such as one containing milk and fat for the detection of proteolytic and lipolytic organisms, respectively, is employed, it can be poured into a plate and each portion of the butter smeared over a segment of the plate.

Many normal and abnormal samples of both commercial and experimental butter have been examined with the technic, using beef infusion agar and an incubation of 4 or 5 days at 21° C; the portions of butter were picked under a low power binocular to keep the size as uniform as possible and averaged approximately 1/20,000 of a gram.

The results indicate that the distribution of bacteria in butter, as regards both numbers and colony types, is often highly irregular. Such a distribution emphasizes that the growth of bacteria in butter is largely limited to certain points, presumably infected moisture droplets. It may be influenced not only by the original contamination of the butter but also by other factors such as irregularites in salt distribution, etc. The plate method gives no information on the distribution of organisms in butter because of the size of the sample taken and mixing of the organisms in it during plating.

The Burri technic often gives lower total counts than the plate method, due probably to the failure to break up clumps of bacteria and to overcrowding on slopes; with heavily seeded slopes it is difficult to distinguish the individual colonies and some organisms may even fail to grow.

Since all of the colonies developing on the slopes are at the surface of the agar, a better differentiation into colony types is obtained with Burri technic than with plates in which some colonies are subsurface. Occasionally, colony types have been noted on Burri slopes which did not grow on plates or which were diluted out in the plates suitable for examination.

M14. The Application of the Phosphatase Test to the Butter Industry.
W. H. Brown, E. H. Parfitt, Purdue University.

The phosphatase test as it is used for milk has been applied to butter to determine whether or not the cream has been properly pasteurizd prior to churning. The Scharer technique, with one ml. of butter serum used to replace the one ml. of milk as the directions indicate, has been followed. The butter serum is collected by centrifuging the sample of melted butter.

The application of the phosphatase test on the butter serum has shown:

That of 372 samples of commercial butter analyzed, 31.2 per cent gave a positive phosphatase test. A larger percentage of the samples that gave a positive phosphatase test, when subjected to the keeping quality test of 15.4° C. for 10 days, dropped in score more than did those that gave a negative phosphatase test.

The butter serum tended to give a more positive reaction than did the corresponding cream and there exists the possibility of the manufacturing process of the butter influencing the phosphatase reaction.

M15. Preliminary Studies of the Neutralization of Cream for Butter-making. R. C. TOWNLEY AND I. A. GOULD, Michigan State College.

In an effort to determine the efficiency of various neutralizers for sour cream and to ascertain the accuracy with which they reduce the acidity of the cream to different calculated acidity ranges, seven neutralizing agents were studied. These neutralizers were sodium carbonate, sodium bicarbonate, a mixed sodium carbonate-sodium bicarbonate neutralizer, a newly recommended commercial product which on the basis of analysis is apparently composed chiefly of sodium and potassium carbonates, sodium hydroxide, magnesium lime, and calcium hydrate.

The original titratable acidity of the cream used throughout this study was approximately 0.5 per cent, expressed as lactic acid. This cream showed a pH of about 4.7 and a fat content of 30 to 35 per cent. The neutralizing factors used were those submitted by the manufacturers for the commercial products, or, in the case of the other products, were those which were found to be correct by the neutralization of lactic acid. The additions of the neutralizers were made on the basis of calculations to reduce the acidity of the cream to the following percentages: 0.25, 0.15, 0.10, and 0.05.

The preliminary findings indicate wide variations in the efficiency of acid reduction by these neutralizers. In general, the carbonate neutralizers failed to reduce the acidity to the calculated point with the reduction being only slightly in error at 0.25 per cent, but being more widely in error when efforts were made to reduce the acidity to a lower range. The ranges of the values secured by the different carbonate neutralizers which correspond to the theoretically expected acidities of 0.25, 0.15, 0.10, and 0.05 per cent, were 0.26 to 0.29 per cent, 0.19 to 0.23 per cent, 0.145 to 0.18 per cent, and 0.13 to 0.165 per cent, respectively.

The limes gave more accurate reductions than the carbonates throughout the acid range studied, with the values being close to those theoretically expected at acidities of 0.25 per cent and 0.15 per cent, but tending to be somewhat higher at the lower acidities. The caustic soda gave the most accurate reduction of any of the neutralizers studied with the values corresponding to 0.25, 0.15, 0.10, and 0.05 per cent, being approximately 0.23, 0.15, 0.11, and 0.075 per cent.

The pH determinations, made before and following the processing, showed variations to occur when different neutralizers were used. When the neutralizers were added at a rate calculated to reduce the acidity of the cream to 0.05 per cent, the average pH values of the cream were as follows: sodium carbonate, pH 6.7; sodium bicarbonate, pH 6.82; mixed soda neutralizer, pH 7.13; mixed sodium and potassium carbonate neutralizer, pH 6.82; sodium hydroxide, pH 7.42; magnesium lime, pH 7.16; and calcium hydrate, pH 7.01.

M16. The Relation of Milk Quality to Grade of Swiss Cheese. L. A. ROGERS, ROBERT E. HARDELL, AND FRED FEUTZ, Bureau of Dairy Industry, U. S. D. A., in cooperation with the Ohio State University and the University of Wisconsin.

While it is generally conceded that milk of low bacterial content is required for making Swiss cheese, no exact data have been available.

Data collected in 1936 and 1937, representing over 400 cheeses made in 20 factories in Ohio and Wisconsin, show that, in general, the number of first-grade cheeses increases directly with the quality of the milk as measured by the methylen-blue test. The effect of the bacteriological condition of the milk is also evident in the development of acid during the making process, which in turn has a definite relation to the grade of the cheese. If the milk is deficient in lactic bacteria so that the pH at dipping is not lower than 6.50 the chances are three to one that the cheese will be undergrade. If there are too many acid-forming bacteria capable of growing at the high temperatures maintained in the kettle and the pH at dipping is below 6.40, the chances of making a first-grade cheese are less than even. If the milk reduces methylene blue in less than 3 hours and the pH at dipping is less than 6.40 the chance of making a first-grade cheese is about one in three. If the methylene-blue reduction time is over 3 hours and the pH at dipping is between 6.40 and 6.50 the chances that the cheese will be first grade are about three in four.

M17. Clarification of Milk for the Manufacture of Swiss Cheese, with Special Reference to the Use of Mastitis Milk. KENNETH J. MATHESON, GEORGE P. SANDERS, LLOYD A. BURKEY, AND J. FRANK CONE, Bureau of Dairy Industry, U. S. Department of Agriculture.

Data are presented dealing with the causes for the differences that exist between clarified and unclarified milk, together with the demonstrated value of clarifying mastitis milk used in the manufacture of Swiss cheese. The conclusions are as follows:

There is definitely more oxygen in clarified than in unclarified milk. Oxygen in milk may influence the set of the resulting cheese.

Clarification promotes the efficiency of the Swiss-cheese cultures as determined by pH measurements.

Both unripened and ripened unclarified-milk cheese contains more water than the clarified-milk cheese. Penetrometer readings indicate that the unclarified-milk cheese is softer in texture than the clarified-milk cheese.

The set of the cheese is increased with low as compared to high speed clarification and where low instead of high clarifying temperatures are used for the milk. The set of the cheese is increased, as compared to suitable checks, when the removed slime is returned to clarified milks, and when unclarified gravity cream is employed as a source of fat.

There is a correlation between the set of the cheese and the fat clusters. As the number of fat clusters is reduced the set of the cheese is improved.

Clarified-milk cheese usually contains slightly less lactose at 21 hours than unclarified-milk cheese.

The set of clarified-milk cheese is increased with an increase of the water content. It is also increased when there is an increase of the pH value at 21 hours.

With clarified mastitis milk the number of leucocytes is reduced about two-thirds as compared to the unclarified milk; and the rate of acid development is more rapid at the 8-hour period in the cheese.

The set of the cheese is increased as the number of leucocytes increases.

In 22 comparisons of clarified with unclarified mastitis milk the grades of the cheese were as follows:

Clarified mastitis milk cheese: Fancy, 4.54 per cent; Specials, 22.72 per cent; No. 1, 68.18 per cent; and No. 2, 4.54 per cent.

Unclarified mastitis milk cheese: Special, 9.09 per cent; No. 2, 90.90 per cent.

Clarification of mastitis milk is capable of causing the cheese made from such milk to be a Special, a No. 1, and even a Fancy, instead of a pin-eyed nissler.

There was only 1 typical pin-eyed nissler in the clarified-milk cheese, while there were 17 of this type in the unclarified-milk cheese.

It is to be understood that this question has been attacked solely as a research problem in manufacturing, and no implication is to be made regarding its possible public health significance.

M18. Control of Types of Organisms in High Temperature Starters.

DAVE NUSBAUM AND WALTER V. PRICE, University of Wisconsin.

It is difficult for cheese makers to carry pure cultures of *S. thermophilis* and *L. bulgaricus* under factory conditions. Some Swiss cheese makers desire a mixed culture of the two organisms but experience difficulty in maintaining them in a single starter in the correct proportions. Brick cheese makers using these organisms should probably use a pure or practically pure culture of one or the other. In this study an attempt has been made to propagate and maintain as desired either a mixture or a pure culture of these organisms.

A technique was adopted which can be employed by any factory not equipped with laboratory facilities. By even slight variations either in incubation period, size of inoculation or both, a cheese maker can carry a mixed starter of these two organisms in any desired proportion. Such proportions can be regulated accurately enough for all practical purposes by simply observing the taste and titratable acidity of the starter from day to day. It was found that when a typical mixed starter, consisting of approxi-

mately equal numbers of rods and cocci, is propagated with 5 per cent inoculations and 30 hour incubation periods, it can be changed in a four day period to a mixture containing about 99 rods to each coccus. By using lighter inoculations and shorter incubation periods the same starter in the same time can be made essentially a pure culture cocci. These procedures have been repeated with similar results using several different strains of *S. thermophilus*. All cultures were carried in the same incubator at 37° C. Photomicrographs of stained preparations of each starter have been prepared to show the change in proportion of organisms at the end of each incubation period when the various cultural practices were employed.

Wisconsin operators obtain pure cultures at weekly or bi-weekly intervals from the University Department of Bacteriology. Many of them inoculate each day's starter directly from these cultures until a new supply is delivered. Work is now in progress which shows the length of time that mixed and pure cultures of these starter organisms will remain viable and active when stored at temperatures of 4° C., 20° C., and 37° C.

M19. Methods of Determining Chlorine in Milk and their Application in the Detection of Mastitis. GEORGE P. SANDERS, Bureau of Dairy Industry, U. S. D. A.

Direct titrations of chlorine in milk with silver nitrate and either potassium chromate (Mohr's method) or dichlorofluorescein indicator yield results which are so erroneously high and erratic that the use of either method is not considered justifiable. Digestion by boiling samples in the presence of an excess of silver nitrate together with nitric acid and potassium permanganate (open Carius method), followed by titration with potassium thiocyanate in the presence of ferric alum indicator (Volhard titration), yields quantitatively accurate results.

The latter method has been so simplified, by combining reagents and omitting digestion, that it is both accurate and easy. The recommended procedure is as follows:

Ten cubic centimeters of milk is measured accurately and to it is added a measured quantity of the 0.0291 *N* special silver nitrate solution described below, more than sufficient to combine with all of the chlorine; ordinarily 15 cc. is the amount used. The mixture is stirred slightly and about 100 cc. of water is then added; it is titrated immediately with a 0.0291 *N* (2.828 grams in 1 liter) solution of potassium thiocyanate. The number of cc. of silver nitrate solution minus the titration value, multiplied by 0.01, equals the percentage of chlorine.

Special silver nitrate solution: Exactly 4.944 grams of silver nitrate is dissolved in water; 200 cc. of concentrated nitric acid and 300 cc. of a saturated solution of ferric ammonium sulfate (alum) indicator are added and the mixture is cooled and made up to 1 liter. The solution is standardized against the thiocyanate solution before use.

A study of data obtained in periodic tests in quarter-udder samples of milk from 29 cows, beginning in most cases with first-calf heifers and continuing through more than one lactation, shows that the determination of chlorine is one of the best of the several tests used for the detection of mastitis. Milks with chlorine values above 0.15 per cent were in all cases mastitis-positive; values between 0.12 and 0.15 indicated either suspected or definitely positive cases. Clinical symptoms varied so widely in different quarters of the udder at the same milking that it was found very essential to test quarter samples rather than all the milk of a milking. After the cow's recovery from mastitis, the chlorine value of the milk, like the yield of milk, usually failed to return to the normal level during the same or succeeding lactations.

M20. Controlling the Fat Content of Swiss Cheese in Southern Wisconsin. WALTER V. PRICE, University of Wisconsin.

From July 1936 to June 1937, four analysts measured the daily variations in composition of milk, curd, whey and cheese and recorded observations of the quality of milk and cheese at each of four Swiss cheese factories. These data were obtained from more than 3,800 kettles. The object of this work was to ascertain the feasibility of controlling the fat content of Swiss cheese by analytical and standardizing methods.

The factors responsible for variations in cheese composition are discussed in this report and the limits of accuracy of standardizing methods are indicated. It seems apparent from this study that, although the composition of the kettle milk can be controlled, the unpredictable variations in cheese composition make it impractical at present to attempt to guarantee a minimum of 45 per cent fat in the dry matter of every wheel of Swiss cheese as long as present commercial grades are observed.

M21. Sodium per Borate as a Corrosion Inhibitor for Washing Powders. LAWRENCE L. LITTLE, Meadow Gold Milk Plant, Oklahoma City.

A study was made of the effect of varying amounts of sodium per borate in preventing the corrosion of tin and aluminum in five per cent solutions of sodium meta silicate, trisodium phosphate, and sodium carbonate. Amounts of sodium per borate ranging from five to ten per cent were found to be effective in preventing the corrosion of both tin and aluminum in solutions of sodium meta silicate, while corresponding amounts had no effect in preventing the corrosion of tin and aluminum in five per cent solutions of trisodium phosphate or sodium carbonate. However, combinations of sodium meta silicate and sodium per borate were found to be effective in preventing corrosion of tin and aluminum in solutions of trisodium phosphate and sodium carbonate.

Trisodium phosphate is rendered non-corrosive to both tin and aluminum by the addition of ten per cent sodium per borate, provided at least twenty per cent sodium meta silicate is included in the trisodium phosphate portion.

Sodium carbonate is made non-corrosive to both tin and aluminum when five per cent sodium per borate is added, provided the sodium carbonate contains a minimum of ten per cent sodium meta silicate.

M22. Sterilization by Irradiation—A Possible New Tool for the Dairy Industry. O. F. GARRETT AND R. B. ARNOLD, New Jersey Agricultural Experiment Station.

Recent development of lamps whose radiations have high bactericidal power has led to practical applications of this principle in certain fields of endeavor. The practical sterilization of the surfaces of meats and bakery goods has been successfully accomplished. Installations in restaurants and at soda fountains for the sterilization of drinking glasses have been successful. A battery of these lamps installed above a hospital operating table has resulted in a great decrease in post-operative infections. The practical sterilization of the air of rooms is being studied.

To determine whether this type of death-ray had a possible practical application in the dairy industry a number of preliminary experiments at the New Jersey Station have been completed. Various utensils and containers such as large dippers, pails, ice cream cans, 10-gal. milk cans, and glass milk bottles were seeded with bacteria and then exposed to radiation for various times of exposures. At the end of 3 minutes the 2-quart dippers were completely sterilized, the straight-sided 5-gal. ice cream cans showed 99% destruction and the 10-gal. milk cans showed 95% destruction.

Exposure of a seeded spray vat pasteurizer and a coil vat pasteurizer showed very good bactericidal action of the radiations.

These preliminary results suggest the possibility of practical application of this type of sterilization to the control of bacterial growth in dairy utensils and equipment, to the control of outbreaks of thermophiles, ropy organisms, etc., in dairy plants, to the sterilization of paper and glass milk bottles, and perhaps as a help to the control of disease in the dairy herd.

M23. Kefir Buttermilk. LLOYD A. BURNEY, Bureau of Dairy Industry, U. S. D. A.

A method has been worked out for making buttermilk by the use of kefir grains. The method for the most part consists of immersing kefir grains in milk near the surface for 24 to 48 hours at a temperature of 65° to 70° F. by enclosing them in a cheesecloth bag or by some other porous container.

The advantages of this method of preparing buttermilk are that the culture remains active indefinitely without much danger of contamination, very little equipment or technique is required, and the product produced is highly flavored. The flavor can be varied at will by varying the temperature and

time of incubation and the method of using the grains. Such variations in conditions can be so controlled as to give buttermilk of alcoholic, of mildly acid, or of highly acid taste.

M24. The Present Status of the Development of Fiber from Casein. EARLE O. WHITTIER, Bureau of Dairy Industry, U. S. D. A.

Casein fiber has been produced in Italy on a rapidly increasing scale for the past 2 years and production is now beginning in other countries. The fiber resembles wool, but may be produced of widely differing diameters, lengths, and physical characteristics. The casein required must be made under carefully controlled conditions such as already prevail in a considerable number of our domestic casein plants. One year's production of milk by an average cow (4,000 pounds) will furnish enough casein for 100 pounds of casein fiber.

M25. Whey Solids in Candy. BYRON H. WEBB, Bureau of Dairy Industry, U. S. D. A.

On the basis of experimental work in which whey solids have been incorporated in different types of candy, it appears probable that an important outlet for whey solids can be developed in the candy industry. Two of the three chief solid constituents of whey, lactose and protein, have been shown to be of distinct value in certain candies. Whey protein is of value in candy as an improver of body and flavor. In some candies in which whipped sweetened condensed whey is used, the whey protein is an important factor in foam production. Lactose in candy is essentially a substitute for sucrose and in such a rôle it pleasantly decreases the sweetness of the ordinary confection. The third whey solid, the salt, is of lesser importance and even limits the quantity of whey which may be used in certain candies.

Whey, chiefly in the form of sweetened condensed whey, has proved especially promising in the development of tentative formulas for caramels, fudge and toffee. Some progress has been made in the utilization of whipped sweetened condensed whey as a frappé for candy makers. Highly concentrated sweetened condensed whey with the lactose properly crystallized has been used as a major constituent of fondant. The usefulness of whey in fondant may be limited to colored goods because of its greenish yellow cast and tendency to darken with age.

It has been shown that whey solids can be used in candy, but to the candy manufacturer cost and convenience will be important factors entering any decision to use whey. Sweetened condensed whey probably is the most convenient economical and satisfactory form in which to process whey for the candy manufacturer.

M26. Effect of the Cold Storage Temperature, Pasteurization Treatment, and Homogenization Pressure on the Properties of

Frozen Condensed Milk. RAYMOND W. BELL, Bureau of Dairy Industry, U. S. Department of Agriculture.

Conditions which are optimum for the preservation of the flavor of frozen condensed milk of 8 per cent fat content may not be most favorable for the body of the product.

Best results were obtained when the condensed milk was (1) stored at minus 7° C., (2) heated to 76.5° C. and held 8 minutes, and (3) homogenized at 2,000 to 3,000 pounds' pressure per square inch.

M27. Consumer Preference as Related to the Analysis of Vanilla Ice Cream in Tennessee. THOS. B. HARRISON, H. B. HENDERSON, AND C. E. WYLIE, University of Tennessee.

Is there any relationship between the consumer preference for vanilla ice cream and the analysis of it? Does the consumer want the rich ice cream or is it more important for the flavor to be clean and the texture smooth? How much variation is to be found in Tennessee ice cream? A project is in progress at the University of Tennessee to determine the relationship of consumer preference to the analysis of ice cream.

Ice cream plant managers all over the state expressed a willingness to cooperate by sending one-gallon samples of vanilla ice cream and their laboratory record on fat, serum solids, sugar, gelatin, and eggs upon requests made by the secretary of the Tennessee Dairy Products Association.

Requests are made for the samples to be sent from six plants at one time. A pint sample is taken from each gallon for analysis, which includes the Mojonnier tests for fat and solids, the pH test by the Beckman meter, and the acid test. It was found that six samples are about all that the untrained, unprofessional judge of ice cream cares to pass judgment on at one time.

Stenographers, Extension staff members, Experiment Station workers, professors, and students are invited to express their preference on the six samples. They are asked to place the sample they like best first and the sample they like least at the bottom. Then they are to pick the second best and the next to the poorest. Then only two samples remain to decide upon. Such procedure makes their task less confusing. Each lot is judged by fifty or more people working independently of one another.

A table will be presented showing the results of this investigation as to formula, composition, and consumer preference. The forms used in recording the results and reporting to the cooperating companies will be shown.

M28. The Use of Moving Pictures in Ice Cream Investigations. W. H. REID, W. S. ARBUCKLE AND R. J. DREW, Missouri Agricultural Experiment Station.*

Preliminary studies have been made in regard to the use of ordinary

* Contribution from the Department of Dairy Husbandry, Missouri Agr. Exp. Sta., Journal Series No. 555.

colors and chromatic films taken with moving picture equipment showing the relation of variable mix compositions, effects of manufacturing procedure and subsequent treatment to which ice creams may be subjected.

This investigation has been limited to the application of moving pictures in studying the stability of ice creams. The ice creams and sherbets studied include those of common flavors, also fruit and nut ice creams.

The use of moving pictures permits acquisition of more complete detailed data than is obtainable when the usual procedure is followed. Availability of data so recorded emphasizes certain factors which may not otherwise be observed.

The report of this investigation will be illustrated by the use of moving pictures showing the effectiveness of this procedure.

M29. Application of the Phosphatase Test to Determine the Efficiency of Pasteurization of Ice Cream Mix. A. J. HAHN AND P. H. TRACY, University of Illinois.

Preliminary results of a study being made at this station have shown that the phosphatase test can be successfully used with certain limitations to determine the efficiency of pasteurization of ice cream mix.

Scharer's test[1] is being used for these determinations and a photoelectric procedure for determining color intensities.

Variations in temperature of pasteurization and in the holding period could be detected, while the use of raw ingredients as compared to pasteurized ingredients before pasteurization had no appreciable effect on the phosphatase content of the final pasteurized product.

Pure vanilla extracts added to the mix had no effect in the final results of the test, while imitation and artificial vanilla extracts increased the phenol value. The use of vanillin and coumarin crystals in ice cream mix, flavored to taste, produced striking results. Coumarin increased the phenol value over ten times that of the control sample, while vanillin produced a greenish tint which made it impossible to compare with the desired blue color.

Six different kinds of fruit flavored extracts were added to the ice cream mix and were found in five out of six cases to increase to a small degree the phenol value.

Three different kinds of cold pack fruits were added to the ice cream mix and in each case appreciably raised the phenol value of the test.

Storing mix during the aging period of two days at 40° F. decreased to a very small degree the phenol value of the test in the underpasteurized samples, but had no effect on the pasteurized samples. No change in the phenol value was noticed after the ice cream had been drawn from the freezer as compared to the aged mix. Storage in hardening room showed a slight decrease in phenol value for underpasteurized samples but no effect on pasteurized sample.

[1] JOURNAL OF DAIRY SCIENCE. Jan. 1938, p. 21.

M30. Influence of Certain Mix Components Upon the Rate at which Freezing Occurs in Ice Cream as Measured by the Dilatometer Method. W. C. COLE AND J. H. BOULWARE, University of California.

Dilatometer measurements were made on the rate at which freezing occurred in ice cream that was maintained during the observation at 2.5 degrees C. below the freezing point of the mix. For a given comparison it was necessary to adjust the freezing points of the mixes to the same value $\pm 0.05°$ C. This was done by adding sodium chloride in the proper amounts to those mixes whose original freezing points were above the lowest freezing point value in a given series of samples.

On the basis of this method the relative effectiveness of fat and milk-solids-not-fat in retarding the rate at which freezing occurred in ice cream was evaluated. It was found that the milk-solids-not-fat were more effective than fat in retarding the rate of freezing.

When these results were compared with the texture of ice cream made from the same mixes, the smoothness of the ice cream was improved to a greater extent by the milk-solids-not-fat than by the fat, provided ice crystal size was used as the basis of determining smoothness. Although deviations from this occurred when the organoleptic test was used as the basis of evaluating smoothness, the results from the two methods were generally in good agreement.

M31. A Study of Quality Variations in Summer and Winter Made Cheese. J. C. MARQUARDT, New York Agricultural Experiment Station.

Low quality in winter made cheddar cheeses causes numerous factories to operate at a loss during the winter period. The industry regards this as one of its main problems.

In New York, Wisconsin and the cheese sections of Canada the so-called winter cheese period extends from November 15th to May 21st. These dates may vary slightly with season. Data were collected in an organized manner regarding the quality of summer and winter made cheeses from the above mentioned sections. Experimental cheeses were also made to study these variations. The work thus far has revealed the desirability of expressing the degree of cheese flavor with the numerical score in comparing cheeses. The results obtained with the commercial and experimental cheeses indicate that the development of cheese flavor in summer made cheeses is much faster than in those made during the winter period. The numerical scores do not follow a comparable trend.

Cheeses made during both seasons were cured at temperatures derived from a cross index plan so that winter made cheeses were cured under summer conditions and vice versa. The cross index system supplied information on

curing temperatures beyond those normally encountered during the two seasons. These data are interesting and supply clues for curing procedures. They do not explain the variations obtained in winter and summer made cheeses. It is planned to cross index the temperatures at which milk is stored so that milk produced during both seasons will be subjected to comparable conditions. Increasing the calcium content of the milk increased the rate of breakdown in texture of cheeses made during both seasons.

M32. Starters Used in Wisconsin Brick Cheese Factories. WILLARD L. LANGHAUS, PAUL R. ELLIKER, University of Wisconsin.

In 1936 a survey of forty Brick cheese factories in Wisconsin revealed that a wide variety of starters were used to develop acid during the manufacturing process. A few operators carried starter cultures. Most of them, however, were using natural starters of various types. Troubles with starters and defective cheese were most commonly observed during the months of July and August. From the forty factories, observed in 1936, twelve were selected in August, 1937, for a more careful study, the results of which are reported here.

One day was spent at each of the twelve factories. Samples of starter, mixed milk delivered by each patron, and a composite sample of all milk delivered on that day were taken at each factory, iced and brought to the laboratory for analysis.

The approximate numbers and the dominant types of organisms in starter and milk were determined by means of a series of dilutions in litmus milk, followed by incubation at 20°, 37°, and 48° C., by means of Burri slopes and by microscopic examination. A week after the observations were made in each factory, a sample of cheese was obtained to determine the quality of the finished product.

Large numbers of thermoduric types of acid-producing organisms were found in the starters. Yeast, gas-forming organisms of the Escherichia-Aerobacter group, as well as other undesirable types were commonly present, sometimes in large numbers.

There was a rather close correlation between the quality of the starter, as determined by the types of organisms present, and the quality of the cheese obtained from the factory. When starters of good quality were used in milk of inferior quality the chances of producing a superior types of cheese seemed to be greatly improved. The results of this study indicate that better cultures and improved methods of propagating starter are badly needed in Wisconsin Brick cheese factories.

M33. Methods Which Help to Retain Fat in American Cheddar Cheese at High Temperatures. HARRY L. WILSON, Bureau of Dairy Industry, U. S. D. A.

A method has been developed for manufacturing American Cheddar cheese so that the fat will not leak out when the cheese is held at relatively high temperatures. The method consists of separating the cream from the milk by adjusting the cream screw of the separator so as to produce cream having a fat content of 40 per cent, heating the resulting cream to from 100° to 142° F. and homogenizing it at from 500 to 2000 pounds' pressure per square inch. If the cream is not heated to 142° F. before it is homogenized, it is heated to 142° immediately after homogenization, held 30 minutes, and standardized to the fat content desired for making cheese with pasteurized skimmed milk. Or the homogenized cream can be standardized with raw skimmed milk and the mixture pasteurized immediately by heating to 142° and holding 30 minutes.

From this point on it is necessary to modify the manufacturing method slightly. The finished product will have all the characteristics of a normal American Cheddar cheese, except that there will be no oiling off nor leakage of fat when it is exposed to temperatures as high as 85° F.

M34. X-Ray Diffraction Analysis of White Specks in Cheddar Cheese. S. L. TUCKEY, H. A. RUEHE, AND G. L. CLARK, University of Illinois.

Babcock, Russell, Vivian and Baer in 1902 described the conditions favoring the formation of white specks during the ripening of cheddar cheese. Val Slyke and Publow in 1910 claimed that the white specks were calcium soaps formed as a result of the combination of fatty acids liberated by bacteria acting only at low temperatures.

By x-rays analysis it has been shown that the white specks isolated from well ripened cheddar cheese have the same crystal structure spacings as calcium lactate. A few of the "d" spacings are listed:

"d" spacings in Angstrom units white specks		"d" spacings in Angstrom units standard calcium lactate	
d_1	11.930	d_1	11.860
d_2	9.845	d_2	9.810
d_3	4.427	d_3	4.400
d_4	3.607	d_4	3.580
d_5	3.280	d_5	3.260
d_6	3.080	d_6	3.080

Since the "d" spacings are specific for the various substances, the white specks in cheddar cheese are apparently crystals or deposits of calcium lactate.

M35. Studies on the Ripening of Blue Cheese. C. B. LANE AND B. W. HAMMER, Iowa Agricultural Experiment Station.

Comparisons of cheese made from homogenized pasteurized milk and from homogenized raw milk have been continued. Pasteurization of the

milk should control certain defects sometimes present in cheese made from raw milk, especially during periods when the milk is of relatively poor quality. Cheese made from homogenized pasteurized milk did not show extensive fat hydrolysis of the odor of methyl-n-amyl ketone until after conspicuous growth of the mold, whereas cheese made from homogenized raw milk developed definite fatty acid and ketone flavors very early. Approximately 6 months of ripening were necessary before the cheese made from homogenized pasteurized milk developed a satisfactory blue cheese flavor; while only about 3 months were required with cheese made from homogenized raw milk.

The addition of a small amount of salt (2 per cent of the estimated weight of curd) to the curd, immediately before hooping, appeared to be a desirable procedure in the manufacture of blue cheese from homogenized milk. Cheese made from salted curd usually developed a more rapid and extensive mold growth than cheese made from unsalted curd, presumably due to the comparatively open texture, and the color was commonly less yellow.

Cheese made from milk produced by cows feeding on a ration high in cracked soybeans was regularly less colored than cheese made from ordinary milk. No definite difference in the flavor of the two types of cheese was apparent.

Loaf cheese, weighing about 5 pounds each, were made in special forms. The cheese ripened normally and the quality compared favorably with that of normal shaped cheese. The loaf cheese appears to be more practical than the usual cheese for retail stores where small slices are cut from a cheese.

M36. Studies on the Vitamin *A* Content of Cheese. I. L. HATHAWAY AND H. P. DAVIS, University of Nebraska.

The vitamin A content of twenty-two kinds of cheeses was studied by feeding these cheeses to rats whose body stores of vitamin A had been exhausted by being fed a vitamin A deficient diet. Twelve experiments were made in which approximately eleven hundred rats were used. From the data obtained it was evident that all cheeses do not have the same vitamin A value. Certain kinds appear to be good sources of this vitamin while other kinds are only fair to poor sources.

M37. Plant Experience with Sonic Soft Curd Milk. LESLIE A. CHAMBERS, Eldridge Reeves Johnson Foundation and University of Pennsylvania.

Homogenization of milk with the 360 cycle sonic oscillator has been studied under operating conditions in a few plants over periods of time ranging from three weeks to about one year. The data show that a unit handling milk at 250 gallons per hour with a power consumption of 4 kilo-

watts will reduce the fat particle size sufficiently to eradicate creaming. Simultaneously, there is a reduction of at least 50 per cent in curd tension with a final value never greater than 30 grams. Furthermore, there is a reduction of 50 per cent or more in the residual bacterial count after pasteurization and an improvement in both body and apparent flavor of the product.

Sonic homogenization has been compared directly with both high and low pressure methods. It has been found that both the sonic apparatus and low pressure homogenizers permit recovery of a much larger proportion of fat from returned milk than is the case when pressures above 2000 pounds are employed.

It should be emphasized that the terms "homogenized milk" and "soft curd milk" are not synonymous, since it is possible to obliterate creaming without having much effect on the curd tension. Many homogenized milks now marketed should not be called "soft curd."

The leucocytic sediment normally found in milks homogenized under conditions which produce the soft curd quality does not appear in bottles of sonized milk. This is possibly due to the fact that sonic cavitation completely disintegrates the white cells.

There is evidence that the phosphatase test is not valid when applied to homogenized milks since the processing apparently inactivates the enzyme wholly or in part.

M38. The Digestibility of Natural and Processed Soft-Curd Milks. C. C. Flora and F. J. Doan, Pennsylvania State College.

The digestibility of natural hard-curd and soft-curd milk as well as that of soft-curd milk produced by boiling, by homogenization, by base exchange treatment, by enzymatic digestion, etc., has been determined, using an *in vitro* method developed by the authors but based on that of Doan and Welch. This method gives an indication of the rate of peptic breakdown (stomach emptying) and also of tryptic digestion which follows. The results obtained *in vitro* have been checked by feeding rats, kept for a period without food, and noting the progress of digestion by post-mortem examination of the digestive tract.

Briefly, the *in vitro* method consists in coagulating milk in small flasks, treating the coagulum with a digestion mixture of HCl and pepsin, agitating it mildly in an incubator at 37° C. and examining replicate flasks at definite intervals. The pH is adjusted periodically, beginning with approximately pH 6.0 and lowering to about pH 3.5 at the end of 2½ hours. Peptic digestion is measured by making nitrogen determinations on the material from the flasks which passes through a 12-mesh screen, at hourly intervals. At the start of the fourth hour the contents of the flasks are adjusted to about pH 7.0 with NaOH and trypsin is added. The pH is raised to about 8.1

at the end of the fourth hour and tryptic digestion is noted by making nitrogen determinations on tri-chlor-acetic acid filtrates at hourly intervals. In some cases sodium tungstate filtrates have been used in an effort to determine the degree of protein degradation.

Preliminary results indicate that natural soft-curd milk digests considerably faster than natural hard-curd milk in both peptic and tryptic digestion. Boiling milk retards the action of pepsin on the protein but the mechanism of physical breakdown in the stomach is more rapid and complete, so that by the method used, more rapid peptic digestion is indicated. Trypsin action is accelerated by the boiling of milk and total digestion at 6 hours is noticeably in advance of the unboiled milk.

The data covering other types of soft-curd milk are not sufficient to warrant conclusions at the time this abstract is being written but will be available for interpretation at the meetings.

M39. The Relationship Between Curd Tension and Curd Size. LESLIE A. CHAMBERS AND IRVING J. WOLMAN, Eldridge Reeves Johnson Foundation and University of Pennsylvania.

Apparatus has been developed for studying *in vitro* curd formation under controlled conditions approximating those in normal and pathological human stomachs. With the new technique it is possible to measure the total curd surface presented for gastric digestion and thus to evaluate measurements of curd tension as indices of digestibility.

When curd surface areas are compared with the usual curd tensions there is general agreement with the theory that curd tension is an index of the rate of gastric clearance, but there are exceptions to this rule in the cases of milks subjected to drastic additions or subtractions. Thus, diluted milk while lowered in curd tension, gives about the same surface number as the undiluted base.

We have examined several hundred samples including most of the available types of certified, raw, pasteurized, homogenized, sonized, enzyme treated, base exchange processed, condensed, evaporated, and dried milks as well as a wide variety of modifications used in the feeding of infants. The data permit a preliminary evaluation of the curd-forming properties, free from any limitations of the curd tension test.

M40. Artificial Gastric Digestion of Milk. MAURICE E. HULL, M. & R. Dietetic Laboratories, Inc., Columbus, Ohio.

Since the development and use of the Hill test for determining curd tension of milk there has been an extensive use of this method by the dairy industry. It has caused an advance in the knowledge of how milks behave in the animal stomach. Milks of low curd tension have been shown to be beneficial in human digestion. However, it has been difficult to measure

digestion. In order to shed some light on gastric digestion of milks the author has developed an artificial method of studying this function of the stomach.

The method was designed for the formation of the curd at the optimum reaction for the production of an enzyme curd followed by changing this reaction to one for optimum pepsin digestion. Gentle agitation was maintained throughout the method. The degree of digestion being measured by a protein determination of the filtered digestion mixture.

GENERAL SESSION, WOOSTER

3. **The Inter-Relationship of Production and Manufacturing Research in the Development of the Dairy Industry.** ERNEST L. ANTHONY, Dean of Agriculture, Michigan State College.

The dairy industry is the wonder child of American Agriculture. Less than a century ago it was unknown, unhonored, and rather despised as an occupation or activity,—principally limited to women, the kitchen, and the backyard. From this humble and insignificant start, it has steadily and with increasing momentum come from behind to be the present day leader of the several important phases of American Agriculture.

This phenominal advancement or change has been largely the result of the consistent application of the sciences to its problems. It is no idle boast to say that no other phase of agriculture has been so completely influenced and guided by scientific principles as has the dairy industry. These principles have been adopted and applied through the medium of research. This research has not been the development in the production field or the manufacturing field alone but fortunately has been advanced in both fields through close coordination. This close coordination or inter-relationship has made possible a united front on the problems of the industry. The research work on vitamin introduction through production methods and its retention through processing and distributing procedure; the studies in quality incorporation in production and its value in manufacturing practices; the researches in consumer demand and market limitations and the adjustment in production methods to satisfy the problem are only a few typical examples of the close inter-relationship which has been so important in the dairy development of the last half a century.

PAPERS READ BY TITLE

1. **The Relation of Milking Machines to the Incidence of Mastitis.** EDWARD B. MEIGS, HENRY T. CONVERSE, Division of Nutrition and Physiology, and LLOYD A. BURKEY, MORRISON ROGOSA, AND GEORGE P. SANDERS, Bureau of Dairy Industry, U. S. Department of Agriculture.

The introduction of machine milking in a herd of cows maintained for nutrition work by the U. S. Department of Agriculture was followed by a severe outbreak of mastitis. During the outbreak and after it had subsided, the chlorides and the numbers of leucocytes and bacteria were determined in numerous samples of milk while the cows were on various modifications of machine milking and on hand milking.

The modifications of machine milking chiefly studied were "severe machine milking," in which the vacuum used was high, the machines were left working on the udders for rather long periods, and the cows were stripped by massaging the udders while the machines were still working on them; and "mild machine milking," in which the vacuum and periods of milking were lessened and the cows were stripped by hand. Some of the cows milked by all methods had had previous cases of mastitis, and some had not.

In the milk of the cows milked by hand, the chlorides and the numbers of leucocytes and bacteria have remained at low levels and the milk yields have been normal in almost all instances, whether or not the cows had had previous cases of mastitis. For the cows subjected to severe machine milking, the results have been variable; but, in almost all instances, high leucocyte counts have appeared in the course of a few days or a few weeks, which usually were not accompanied immediately by increased bacterial counts. After a further variable interval of several days or weeks, large numbers of bacteria have appeared in the milk in the majority of instances, accompanied by a great increase in chloride content, rapid reduction in milk yield, and other signs of acute mastitis. A change to hand milking was uniformly followed by a rapid reduction in leucocytes and chlorides, and, in the next lactation period, by a marked recovery in milk yield and by a return of the milk to normal in practically all respects. Mild machine milking has not resulted so far in any severe cases of mastitis, though the leucocytes, and sometimes the chlorides, have tended to be definitely higher than in the case of hand milking.

The tendency of machine milking to produce high leucocyte counts and increased chloride content without accompanying high bacterial counts, and the tendency of hand milking to produce opposite effects, constitute strong evidence for the view that machine milking may sometimes have a mechanically injurious effect on the secretory membranes of the udder. The frequency with which these symptoms of injury have been followed by acute mastitis in the case of severe machine milking indicates that the injury, if carried far enough, renders the udder tissues a better medium for bacterial growth.

It should be emphasized that only one type of milking machine has been studied so far, and that no severe cases of mastitis have followed its use, except under the conditions of "severe machine milking" or conditions approaching thereto. The results should by no means be taken to prove that machine milking in general will be accompanied by a greater incidence of mastitis.

2. Sudan Grass Hay vs. Clover Hay for Dairy Cows. C. E. WYLIE AND S. A. HINTON, University of Tennessee.

Years of drought frequently require the use of emergency crops in feeding dairy herds. Sudan grass is such a crop since it may be grown late in the summer. It makes a rapid growth and great tonnage. It is of value, therefore, to obtain information on its feeding value even for a short time.

During the winter of 1936–37 an experiment to determine the value of Sudan grass hay for dairy cows was set up at the University of Tennessee. Two groups of Jersey cows, four cows in each group, were used. Group I was fed a ration of grain, silage, and Sudan grass hay. Each cow received 20 pounds of silage daily. Grain was fed each cow at the rate of one pound of concentrates to three pounds of milk produced. Each group was fed all the hay that they would eat. Accurate weights of the amounts of feed fed and refused was kept and recorded daily. At the end of forty-five days the kind of hay that each group was fed was reversed, Group I receiving Sudan grass hay and Group II receiving clover hay. Milk weights were kept and the milk was tested one day each week for butterfat. The cows were weighed one day each week and weights recorded. On the basis of this short time experiment, Sudan grass hay was worth approximately five-sixths as much as clover hay as a feed for dairy cows. The cows in both groups maintained normal body weight during the experiment. The cows were never off feed and kept in good physical condition. All of the cows bred and calved normally.

3. The Extraction and Assay of the Hormones of Cattle and Sheep Pituitaries. A. J. BERGMAN AND C. W. TURNER, University of Missouri.*

It has been shown that the milk yield of dairy cattle can be increased by the injection of certain anterior pituitary extracts. Since it is assumed that the hormones of the pituitary directly (lactogenic) and indirectly (thyrotropic, parathyrotropic, adrenotropic, carbohydrate, fat and protein metabolism) influence lactation, considerable attention has been given to the chemical extraction, separation, purification and biological assay of these factors. In order to investigate the relation of the several hormones to lactation, it is desirable to have available assayed pituitary extracts.

All of the hormones mentioned have not been separated nor have assay methods been developed. However, assay techniques for the lactogenic, thyrotropic, carbohydrate metabolism and gonadotropic hormones have been developed and the units defined. For assay of the lactogenic hormone the common pigeon is used; for the thyrotropic and carbyhydrate metabolism the immature male guinea pig. Since the gonadotropic hormone is considered as

* Contribution from the Department of Dairy Husbandry, Missouri Agr. Exp. Sta., Journal Series No. 561. Aided in part by a grant from the Committee on Research in Endocrinology of the National Research Council.

a contaminant as far as lactation is concerned, its presence must be determined. For this test animal the day old chick is used.

The anterior lobe of both sheep and cattle pituitaries have been used as a source of the hormones. The anterior lobes are ground, dried with acetone and assayed for the lactogenic, thyrotropic, carbohydrate metabolism, and gonadotropic content. Approximately 85–90 per cent of the inert material is then removed by extraction with alcohol at pH 9–10. This extract referred to as the *initial*, is again carefully assayed. The lactogenic hormone (I) is then separated from the thyrotropic, carbohydrate metabolism and gonatropic hormones (II). It (I) is then further purified and upon assay has been shown to be relatively free of other hormones. The fraction containing the thyrotropic, carbohydrate metabolism, and gonadotropic (II) is then assayed. Further attempts are being made to separate this fraction. The lactogenic (I) potency has been increased from 500 to 6600 units per gram. The fraction containing the thyrotropic, carbohydrate metabolism and gonadotropic (II) has been increased as follows: thyrotropic, 50 to 4000 units per gram; carhohydrate metabolism 20 to 660 units per gram; and the gonadotropic from 250 to 10,000 units per gram.

4. **Relation of Lactic Acid and Glucose of the Blood and Glycogen in the Mammary Gland to Milk Secretion.** W. E. PETERSEN, J. C. SHAW, University of Minnesota.

It has been shown recently that the active mammary gland removes both lactic acid and glucose from the blood. From this it was postulated that glucose and lactic acid are used by the mammary gland for the synthesis of lactose. This hypothesis was proven to be correct by Peterson and Shaw who succeeded in synthesizing lactose *in vitro* from glucose plus lactic acid and mammary gland tissue. Lack of a definite relationship between the amounts of glucose and lactic acid removed by the mammary gland from time to time suggest some other mechanism is involved in the process of lactose synthesis.

These variations could be accounted for by a storage of carbohydrate in the gland. Analysis of both lactating and non-lactating glands showed an average of 0.2 per cent of glycogen on the basis of the total weight of the gland. The glycogen, temporarily stored in the gland, is therefore probably built up from the blood carbohydrate when large amounts are taken out by the gland and becomes a source of the lactose precursors when small amounts of carbohydrate are taken out of the blood.

5. **The Carotene Requirement of Dairy Calves.** RUEL E. WARD, S. I. BECHDEL, AND N. B. GUERRANT, Departments of Dairy Husbandry and Agricultural and Biological Chemistry, Pennsylvania State College.

In an effort to determine the carotene requirement of growing calves, twenty-seven animals (20 Holsteins and 7 Guernseys) have been fed varying amounts of carotene from the following sources: Alfalfa hay, timothy hay, corn silage, alfalfa silage, yellow corn, and a commercial carotene preparation (Puratene). The carotene content of the different materials was determined by the Struve modification of the Guilbert method.* When alfalfa hay or Puratene (carotene in cottonseed oil) was used as the source of carotene, 12 to 14 micrograms of carotene per pound body weight per day was sufficient to prevent the symptoms of vitamin A deficiency. These results agree very well with those reported by Hart and Guilbert. When timothy hay or corn silage was given as the source of carotene the requirements were about 25% higher than the values mentioned above. The results to date with alfalfa molasses silage indicate that the requirement may be even greater than this latter value. The differences noted above are probably due to the fact that with some materials the method of carotene estimation is complicated by the presence of carotenoids other than beta carotene.

Increased growth or improved well being in Holstein calves did not result when the carotene was supplied above 20 to 30 micrograms per day per pound body weight. The results to date indicate that minimum requirements of carotene for Guernsey calves are not appreciably higher than for Holstein calves. The Guernseys, however, appear to be more subject to intestinal and respiratory disorders at low carotene intakes. The general results of the experiment indicate that calves have a slightly higher requirement for carotene in winter as compared with the summer months. Work with older animals indicates that heifers, one to two years of age, will probably show little or no carotene deficiency in the winter months if they have been on good pasture during the previous summer.

6. **Revised United States Standards for Quality of Creamery Butter.** ROY C. POTTS, Principal Marketing Specialist, United States Bureau of Agricultural Economics.

The Revised Tentative United States Standards for Quality of Creamery Butter became effective April 1, 1938 by approval of Dr. A. G. Black, Chief of the Bureau of Agricultural Economics.

By the old standards the five factors, flavor, body, color, salt, and package, were each given an arithmetical rating and the total of those ratings became the final score. Under the Revised Standards the factor of package is eliminated from consideration entirely. The factors of flavor, body, color, and salt are each rated entirely independent of the other, and the final score is determined by the application of a rule and a schedule for defects in body, color, and/or salt which are permitted in butter of a particular flavor rating and do not require the final score to be below the rating given to flavor.

* Permission obtained from Oscar H. Struve, Chemist, Eastern States Feed Mills, Buffalo, New York, to use the method in this study.

The official United States score of individual sample of creamery butter under the Revised Standards is determined by the following general rule: "The official United States score of an individual sample of creamery butter shall be determined by deducting from the flavor rating of the sample the amount that the total ratings of the defects in body, color, and salt is in excess of the ratings for defects permitted in these factors for butter of the particular flavor rating, the official United States score to be experssed as a whole number by lowering any half score to the next lower full score."

To properly apply the Revised Standards, a grader must know the rating established for each identified flavor and he must be able to identify each flavor correctly with respect to its character and its degree or extent of development. Without such knowledge of the various identified flavors a grader would not be able properly to apply the standards for he would not know them. The grading of butter according to these standards, therefore, is not a job for a layman, who has a general knowledge of butter and a generally good taste sense, but if it is to be expertly and properly done, it requires the expert knowledge and the expert experience of a completely and competently trained personnel.

7. **Effect of Temperature and Composition Upon the Physical Properties and Dipping Qualities of Ice Cream.** W. H. E. REID, R. J. DREW AND W. S. ARBUCKLE, University of Missouri.*

This study treats with the composition of the ice cream mix and the effect of serving temperature of vanilla ice cream upon the crystalline structure, stability, consumer acceptance, dipping and keeping qualities of ice creams.

Ice creams varying in fat content from 12 to 16 per cent; serum solids content from 9 to 15.5 per cent; sugar content from 12 to 18 per cent and gelatin content from .20 to .50 per cent were observed at the serving temperatures of 6, 10, 14 and 18 degrees Fahrenheit.

It was observed that as the serum solids of the mixes were increased there was a relative increase in the pH. Variation in the composition of the mixes had no marked effect upon the surface tension. Increasing the solids of the mixes resulted in a relative increase in the viscosity.

The serving of the ice creams at a temperature of 10 degrees Fahrenheit was considered desirable from the consumer's viewpoint. Ice creams containing 14 per cent fat, 13 per cent serum solids and 14 per cent sugar were preferred of the series of mixes studied.

Microscopic examination of the ice creams indicated that as the percentage of fat, serum solids, sugar or gelatin was increased the ice crystals appeared relatively smaller. Macroscopic pictures revealed that increased fat and gelatin percentages increases the stability, while the effect of varia-

* Contribution from the Department of Dairy Husbandry, Missouri Agr. Exp. Sta., Journal Series No. 557.

tion in serum solids and sugar content on stability was influenced greatly by the serving temperature.

Dipping studies show that the serving temperature and composition of the mix affect the number of scoops secured per gallon. The greater number of scoops of ice cream was obtained at a temperature of 6 degrees Fahrenheit. The least number of scoops was usually obtained as the serving temperature was increased, there being a slight decrease in the number of servings per gallon.

The keeping qualities of all ice creams was most favorable when held at a temperature of 6 degrees Fahrenheit. Sandiness did not become apparent in the ice creams containing 13.50 per cent serum solids even when held at the different serving temperatures for three weeks. However, the mixes containing 15.00 per cent serum solids showed indications of sandiness when aged two weeks.

Ice creams served at 10 degrees Fahrenheit had the most desirable eating qualities although a temperature of 14 degrees Fahrenheit was considered desirable. Ice creams served at 6 degrees were described as being too cold with the flavor submerged.

8. **A Comparative Study of Metal and Glass Petri Dish Covers.** HERBERT JENKINS, New England Dairies, Inc.

In commercial laboratories where large numbers of standard plate counts are made daily, the breakage of petri dishes is an expense item to be considered. In order to eliminate a portion of this breakage, a search was made for a substitute for the glass cover. Obviously there could be no substitute for the glass bottom.

Experimental work was undertaken, first, to find a material for the cover which would be non-breakable; second, to determine whether this material would give the same results bacteriologically as glass.

A metal aluminum cover was finally adopted. Metals other than aluminum proved unsatisfactory because of appearance, rusting, warping, weight, discoloration, or the fact that they did not take identification marks easily. Covers of special paper were eliminated because of their expense and the fact that they allowed the agar to dry. Standard plate counts were made in duplicate, using glass and aluminum covers on more than 2,000 samples of milk of varying quality. No difference in the counts, other than the usual variations encountered with the standard plate method, was observed whether glass or aluminum covers were used.

Since results are the same with aluminum, as with glass covers, aluminum petri dish covers have several distinct advantages:

1. They are non-breakable and practically indestructible. For this reason they will last indefinitely, making the unit cost very low.

2. Their original cost is approximately one-third the amount of the pyrex cover.

9. Summary of Experiment with the Delaval Standardizer. J. H. FRANDSEN, Massachusetts State College.

1. Standardization reduces the amount of visible sediment in milk.

2. In general, standardization increases fat and total solids and decreases specific gracity.

3. Standardization has little effect upon bacteria count.

4. Standardized milk tends to have a better flavor than milk of the same age not standardized.

5. Standardization with a mechanical standardizer is more practical and economical than standardization by siphoning or foremilking.

10. Methylene Blue Reduction Time as an Indication of the Suitability of Milk for the Manufacture of Swiss Cheese. A. B. EREKSON, C. A. ECKBURG AND E. LEE, The Borden Company.

From two to eight wheels of Swiss cheese were manufactured daily with a few short interruptions in one factory in Clark County, Wisconsin, during the period April 1, 1935 and March 31, 1937. A total of 2463 cheeses were included in the study. Each kettle of milk was sampled before the starter was added and methylene blue reduction tests were made under carefully-controlled conditions. A complete set of records was kept on the manufacturing procedure and the quality of the cheese. The tabulated results indicate a very definite relationship of methylene blue reduction time of the milk to the quality of the cheese with a decided tendency toward better cheese as the reduction time increased up to six hours. The results show that when the reduction time was less than three hours, only one cheese in every 10.08 manufactured was above a "C" in grade, while when the reduction time was over three hours, one cheese in every 3.88 made was either a "B" or an "A" grade.

11. Casein Milk Fat as a Foam Depressant in Casein-Clay Slips. G. A. RICHARDSON AND N. P. TARASSUK, College of Agriculture, Davis, California.

The authors have previously concluded that the relationship between the fat content of casein and its foaming tendencies was somewhat obscure.[1] They later reported that oxidized fat is much more effective in preventing foaming of casein-clay slips than fresh fat.[2] It was postulated that this might account for the decrease in foaming tendency of casein on aging.

Additional studies confirmed this theory and showed that the physical and chemical condition of the fat plays the major, if not the only, rôle in the non-foaming tendency of casein-clay slips.

The spreadability of fresh milk fat on water, sodium casein solutions, and casein-clay slips shows a much lower value than does milk fat which has

[1] JOUR. DAIRY SCIENCE, *20*, 449, 1937.

[2] Proc. 23rd Annual Meet, Western Div. Amer. Dairy Sc. Assoc., pp. 70–78, 1937.

undergone chemical deterioration. This fact explains the foam-depressing action of the fat of commercial casein.

12. **The Relationship of Mastitis Milk and Soft-Curd Milk to the Manufacture of Swiss Cheese.** KENNETH J. MATHESON, LLOYD A. BURKEY, GEORGE P. SANDERS, AND ROBERT R. FARRAR, Bureau of Dairy Industry, U. S. Department of Agriculture.

In order to study the effects of mastitis milk and soft-curd milk on the manufacture of Swiss cheese a detailed survey was made of the milk from individual cows. As a result of this survey the milk was divided into four general groups, as follows: (1) Normal milk; (2) Mastitis milk; (3) Soft-curd milk with slow rennet coagulation, not mastitis; and (4) Normal low and high rennet-curd-tension milks.

As a result of manufacturing cheese from these types of milk, the following conclusions are drawn:

That mastitis milk causes the cheese to overset more than normal milk.

That there is evidence that the mastitis milk has an inhibitory effect upon the development of the lactobacillus (39a).

That there are more glass defects in the normal-milk cheese than in the mastitis-milk cheese.

That cheese made from normal milk has a lower percentage of water than that made from mastitis milk, or with the mixture of mastitis and soft-curd milks.

That the coagulation period is lengthened by the use of mastitis milk as compared to normal milk.

That grades of cheese from mastitis milk, from the mixture of mastitis milk and soft-curd milk, and from the soft-curd milk alone, are better than those of cheese from normal milk.

Of the cheeses made from milk produced by cows free of mastitis, the low rennet-curd tension milk cheese was higher in moisture, softer in texture, and poorer in quality than that made from high rennet-curd-tension milk.

It is to be understood that this question has been attacked solely as a research problem in manufacturing, and no implication is to be made regarding its possible public health significance.

13. **Texas One Day Dairy Shows.** G. G. GIBSON AND E. R. EUDALY, Texas A. & M. College.

The one day Dairy Show or "Dairy Day" was the result of a demand on the part of dairymen, county agents and representatives of milk plants for a program that would recognize excellence in dairy type, production and products.

In planning the Dairy Shows or "Dairy Days" the idea of having a program that would interest both the dairyman and his family was kept in mind.

The main feature of the day was the cattle show. Cattle were classified into Class A, B and C. Ribbons were awarded for each of the classes. At each show the best female and best bull were selected. Certificates were awarded where animals met certain standards of type and production.

A Dairy Cattle Judging Contest for 4–H Club members, F.F.A. members, men and women was carried along with the classification of the cattle. A Dairy Products Contest for women was also included. Samples of milk, cream and butter were scored. Between classes short talks were given by men from Texas A. & M. College and others dealing with problems that concerned the dairymen in that area.

In planning the dairy days a series of preliminary meetings had been held at which committees were appointed to handle the arrangements for each Show. It was left up to the various committees to work out a program for their Show that would best serve their interests.

14. **The Texas Trench Silo Program.** G. G. GIBSON, Texas A. & M. College.

While it has been known for many years that feed can be stored satisfactorily in a trench silo, no concerted effort was made in Texas to bring about a wider use of the trench silo until 1932. In 1932, 523 trench silos were reported by county agents. In 1937 there were 9,483 trench silos containing almost 1,000,000 tons of silage reported in Texas.

In order to arouse interest in and to sell the idea to farmers, several methods have been employed:

(1) Trench silo demonstrations have been set up in various parts of the county. The County Agent arranges a meeting at the trench at time of filling. Other meetings are arranged at the trench when the silage is being fed so that farmers will have an opportunity to see the silage being used.

(3) Trench silo posters have been prepared.

(4) Chambers of Commerce and other organizations have sponsored contests within counties and within certain sections of the state based on increasing the number of trench silos. Other counties have increased the number of trench silos through the effort of the local committees.

(5) Commissioners' Courts in a number of counties have rendered assistance by making equipment available for the construction of trench silos. In the ranch country, equipment used for building tanks in connection with the range program is available for trench silo construction.

(6) The fact that trench silos are adaptable to any kind of conditions and practical for any farm has been kept uppermost at all times. It has been demonstrated that all kinds of crops in addition to regularly recognized silage crops can be stored in a trench silo. Many trenches have been filled in Texas with whole bundle feed so that it is possible for a farmer to have silage who does not have any equipment of any kind for cutting or handling the feed.

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THE CHEMICAL COMPOSITION AND PROPERTIES OF NORMAL AND RANCID JERSEY MILK

II. FAT, TOTAL SOLIDS AND PROTEIN CONTENT

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In a previous paper (6) dealing with milk flavor as related to composition, the chloride and lactose content of rancid milk was compared with that of normal milk from a selected group of Jersey cows. The present paper presents the fat, total solids and protein content of the normal and rancid milk produced by these cows.

Because of the recognized variation in the composition of milk due to such factors as individuality, environment and management, available data could not be used as normal values for the herd under observation. In order to make a direct comparison of the composition of normal and rancid milk at all stages of lactation it was necessary to establish normal values for individual cows and for the whole herd for the entire lactation period. This has been done and the results are reported below.

EXPERIMENTAL

A representative sample of the evening milk from each cow in the herd was taken at weekly intervals. Milk fat and total solids were determined on the Mojonnier. Total protein, casein and albumin were determined by the official methods outlined in the Methods of Analysis of the A. O. A. C. Management of the animals and the method of sampling have been described in a previous paper.

PRESENTATION OF DATA

Fat Content of Normal Jersey Milk

Weekly changes in the fat content of milk from ten cows during a complete lactation are shown by graphs in Figure 1. It is evident from the graphs that the fat of the milk of the individual animal fluctuated appreciably from week to week. The degree of this variation is shown in Table 1

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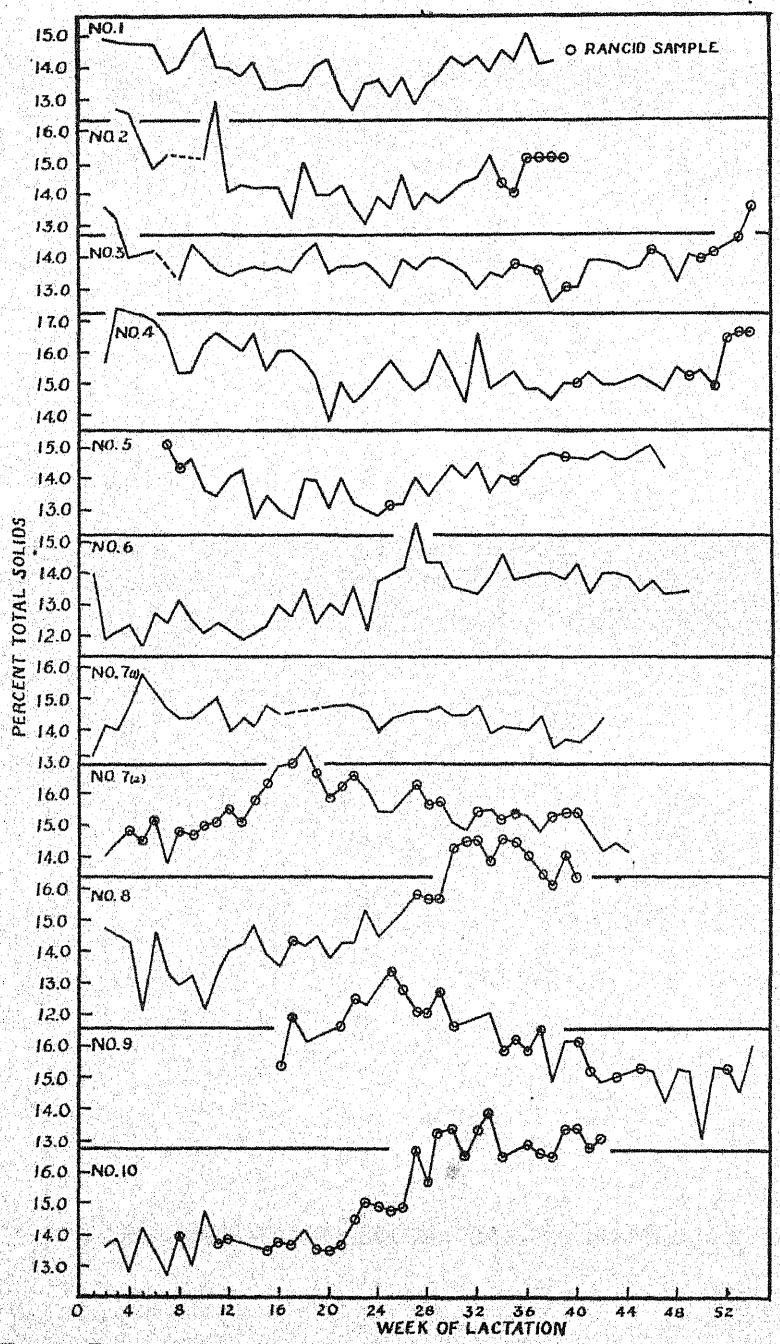

FIG. 1. Fat content of milk samples taken weekly from each of ten Jersey cows during a complete lactation. Rancid samples are indicated by circles.

TABLE 1

Fat and total solids content of normal and rancid Jersey milk produced by ten[1] Jersey cows during a complete lactation

Cow	Milk samples		Fat content					Total solids content				
	Total	Rancid	Mean of normal samples	Mean of rancid samples	Mean of all samples	S. D.[2]	C. V.[3]	Mean of normal samples	Mean of rancid samples	Mean of all samples	S. D.[2]	C. V.[3]
number	*number*	*number*	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*
1	36	0	4.81		4.81 ± 0.08[4]	0.48	10.0	13.96		13.96 ± 0.11[4]	0.67	4.8
2	34	6	5.16	5.12	5.16 ± 0.12	0.67	13.1	14.45	14.77	14.50 ± 0.16	0.91	6.3
3	49	9	4.56	4.95	4.61 ± 0.08	0.55	12.0	13.77	14.00	13.82 ± 0.17	1.23	8.9
4	66	9	5.57	6.83	5.72 ± 0.10	0.83	14.5	15.45	15.86	15.50 ± 0.10	0.81	5.3
5	39	5	5.17	5.24	5.17 ± 0.08	0.48	9.2	13.85	14.19	13.89 ± 0.14	0.88	6.3
6	48[5]	0	4.71		4.71 ± 0.10	0.67	14.3	13.25		13.25 ± 0.13	0.91	6.8
7(1)	36	0	4.98		4.98 ± 0.07	0.42	8.4	14.37		14.37 ± 0.14	0.89	6.2
7(2)	41	25	5.55	5.72	5.65 ± 0.08	0.54	9.5	15.17	15.46	15.34 ± 0.13	0.82	5.4
8	38	12	5.19	7.10	5.84 ± 0.19	1.17	20.1	14.23	16.11	14.82 ± 0.25	1.17	10.6
9	40	22	6.64	7.29	6.98 ± 0.15	0.93	13.3	15.54	16.59	15.96 ± 0.18	1.12	7.1
10	40	29	4.90	6.23	5.76 ± 0.18	1.17	20.3	13.64	15.56	15.04 ± 0.25	1.59	10.5

[1] Two lactations are shown for cow number 7.
[2] Standard deviation.
[3] Coefficient of variation.
[4] Standard error of mean.
[5] Milk criticized as salty during entire lactation.

which presents statistical constants for the mean fat content of the milk of a complete lactation for each of the cows. The mean fat content varied from 4.71 per cent to 6.98 per cent, with coefficients of variation of from 8.4 to 20.1 per cent.

The general tendency for the fat content of milk to decrease during the first weeks of lactation and later to increase is shown in Figure 1; the time of onset of the increase varied with the individual animal. The milk of animal 7 was exceptional in that in both the lactations shown, the fat increased during the first third of the lactation period then decreased slightly as lactation advanced.

Weekly changes in the mean fat content of normal milk of the herd throughout lactation is shown in Figure 2, graph 1. This curve was estab-

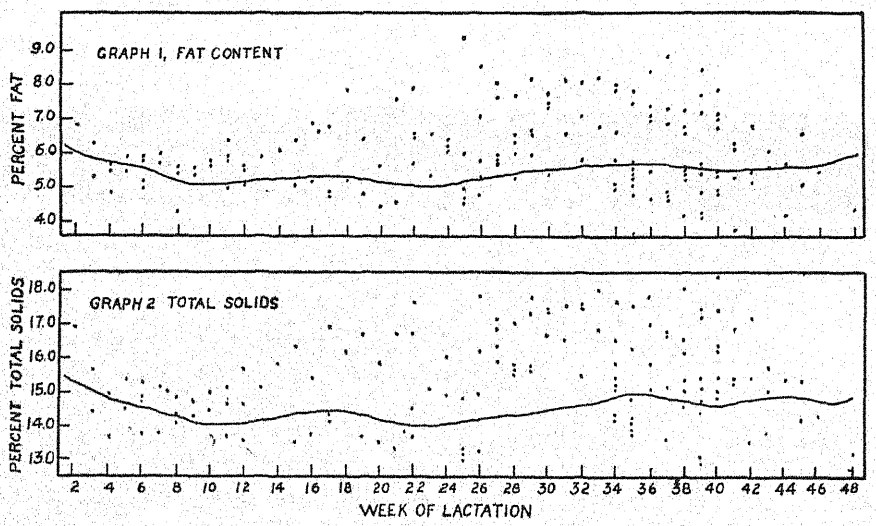

FIG. 2. Fat and total solids content of Jersey milk.

Graph 1

——— Mean fat content of all normal samples for each week of the lactation period.

• Fat content of rancid samples.

Graph 2

——— Mean total solids content of all normal samples for each week of the lactation period.

• Total solids content of rancid samples.

lished by the analysis of 672 individual samples obtained from 20 cows. The general trend of the fat content of milk was marked by a sharp decrease from 6.2 per cent to 5.0 per cent during the first ten weeks of lactation followed by a slow and irregular increase until a fat content of 5.77 per cent was reached in the 48th week.

The above data have been summarized in Table 2 showing the mean fat content of all normal samples for each of 12 four-week periods. The coeffi-

TABLE 2

Fat and total solids content of normal[1] Jersey milk in relation to the period of lactation

Lactation period	Milk samples	Fat content			Total solids content		
		Mean	S. D.[2]	C. V.[3]	Mean	S. D.[2]	C. V.[3]
weeks	*number*	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*
1–4	55	5.72 ± 0.17[4]	1.20	21.9	14.85 ± 0.18	1.36	9.1
5–8	66	5.29 ± 0.12	0.99	18.7	14.43 ± 0.14	1.15	8.0
9–12	57	5.00 ± 0.11	0.77	15.3	14.03 ± 0.12	0.93	6.6
13–16	60	5.20 ± 0.11	0.86	16.4	14.24 ± 0.14	1.10	7.8
17–20	58	5.15 ± 0.11	0.87	16.8	14.27 ± 0.17	1.26	8.8
21–24	61	4.99 ± 0.08	0.67	13.3	14.05 ± 0.13	1.01	7.2
25–28	64	5.20 ± 0.10	0.82	15.8	14.31 ± 0.14	1.08	7.6
29–32	66	5.32 ± 0.11	0.86	16.1	14.50 ± 0.15	1.17	8.1
33–36	54	5.54 ± 0.16	1.13	20.3	14.91 ± 0.20	1.44	9.6
37–40	39	5.36 ± 0.15	0.90	16.9	14.51 ± 0.20	1.25	8.6
41–44	34	5.45 ± 0.13	0.73	13.3	14.71 ± 0.16	0.96	6.5
45–48	20	5.55 ± 0.11	0.48	8.7	14.82 ± 0.23	1.01	6.8

[1] No rancid samples are included.
[2] Standard deviation of mean.
[3] Coefficient of variation of mean.
[4] Standard error of mean.

cients of variation obtained for the fat content of milk from different cows in the same period of lactation were high, ranging, with one exception, from 13.3 per cent to 21.9 per cent, and were somewhat greater than those found for the fat content of the milk of individual animals during a lactation. The average fat content of 672 normal samples was 5.35 ± 0.035 per cent, with a standard deviation of ± 0.912 per cent, and a coefficient of variation of 13.57 per cent.

The decrease in fat content during the first three months of lactation is in agreement with the findings of Van Slyke (7), Eckles (2), Ragsdale (5), and Becker (1), although the drop observed above is somewhat greater than that found by these investigators. The subsequent increase reported by these workers is more regular and slightly greater than was found in the herd under observation. Grady (3), Ragsdale (5), and Becker (1), reported an average fat content of 4.98, 4.98 and 4.605 per cent, respectively, in Jersey milk for the first month of lactation and final values of 5.75, 5.73 and 5.55 per cent, as compared with 5.72 and 5.55 per cent, the initial and final values reported here.

Fat Content of Rancid Samples

A comparison of the fat content of normal milk with that of rancid milk produced during a lactation may be made from the individual graphs in Figure 1 and from the summarized data in Table 1. From these it is evident that the average fat content of rancid samples exceeded that of normal samples from the same animal and that the average fat content of all samples taken during a lactation was higher for animals 7 (2), 8, 9 and 10, frequently producing rancid milk, than for animals 1, 6 and 7 (1), which produced no rancid samples. The average for the former group ranged from 5.65 per cent to 6.98 per cent, that of the latter from 4.71 per cent to 4.98 per cent. It is also of interest to note that during lactation 1 of animal 7, when no rancid milk was produced, the average fat content of the milk was 4.98 per cent, whereas in the succeeding lactation when 61 per cent of the samples analyzed were rancid, the average fat content was 5.65 per cent.

In Figure 2, graph 1, one may compare the fat content of rancid samples with the average fat content of normal milk in the same week of lactation. The tendency is obviously toward a higher fat content in the rancid samples, although many of the values fall within the limits of normal variation as set down in Table 2.

Table 3 shows the average fat content of all normal samples and of rancid samples grouped according to their degree of rancidity and without regard to the period of lactation in which they were produced. The average fat content of the three groups of samples designated as "rancid," "slightly" and "doubtfully rancid" were 6.17, 6.02 and 6.07 per cent, respectively, and were appreciably higher than the mean fat content of 5.35 per cent for all

TABLE 3

Fat and total solids content of normal and rancid Jersey milk

Description of samples	Milk samples	Fat content		Total solids content	
		Mean	Standard deviation	Mean	Standard deviation
	number	*per cent*	*per cent*	*per cent*	*per cent*
Very rancid	5	5.31	0.34	14.96	0.34
Rancid	33	6.17	0.99	15.79	1.25
Slightly rancid	64	6.02	1.40	15.28	1.79
Very slightly rancid	18	5.21	0.53	14.69	1.48
Doubtfully rancid[1]	47	6.07	1.08	15.45	1.38
Rancid (total)[3]	167	5.96 ± 0.09	1.19	15.35 ± 0.12	1.52
Normal (total)	672	5.35 ± 0.04[2]	0.91	14.53 ± 0.02[2]	0.53

[1] Criticized as rancid by less than half the judges.
[2] Standard error of mean.
[3] Total samples scored as having some degree of rancidity.

normal samples. Peculiarly, the few samples described as "very" rancid had a fat content practically the same as that of normal milk.

The average fat content of 167 rancid samples was 5.96 per cent as compared to 5.35 per cent the average of 672 normal samples. The difference between the two values is 0.61 per cent which is 6.2 times the standard error of the difference, $\pm$ 0.0986 per cent, and is therefore significant.

Total Solids Content of Normal Jersey Milk

The total solids content of milk paralleled that of the fat content, showing similar fluctuations from week to week. Weekly variation in the total solids content of the milk of individual cows are shown by graphs in Figure 3. The degree of the variations is indicated in Table 1 by statistical constants for the mean total solids content of the milk of the individual cows for an entire lactation. The mean total solids content for the ten animals represented varied from 13.25 per cent to 15.96 per cent, with coefficients of variation ranging from 4.79 to 10.54 per cent, with an average coefficient of 7.29 per cent.

Weekly changes in the mean total solids content of the milk of the herd throughout lactation are shown by graph 2 in Figure 2. The trend of total solids content throughout lactation was the same as that observed in the fat content. During the first 10 weeks the total solids decreased from 14.85 per cent to 14.03 per cent, after which it took an upward trend, interrupted at times by slight drops, reaching a final value of 14.82 per cent in the 48th week of lactation.

The statistical significance of the above data is shown in Table 2 which presents constants for the mean total solids content of all normal samples for each of the 12 four-week periods. Variation in the total solids content of milk of different animals in the same period of lactation was the same as that shown by the individual animal in the course of a lactation. The mean total

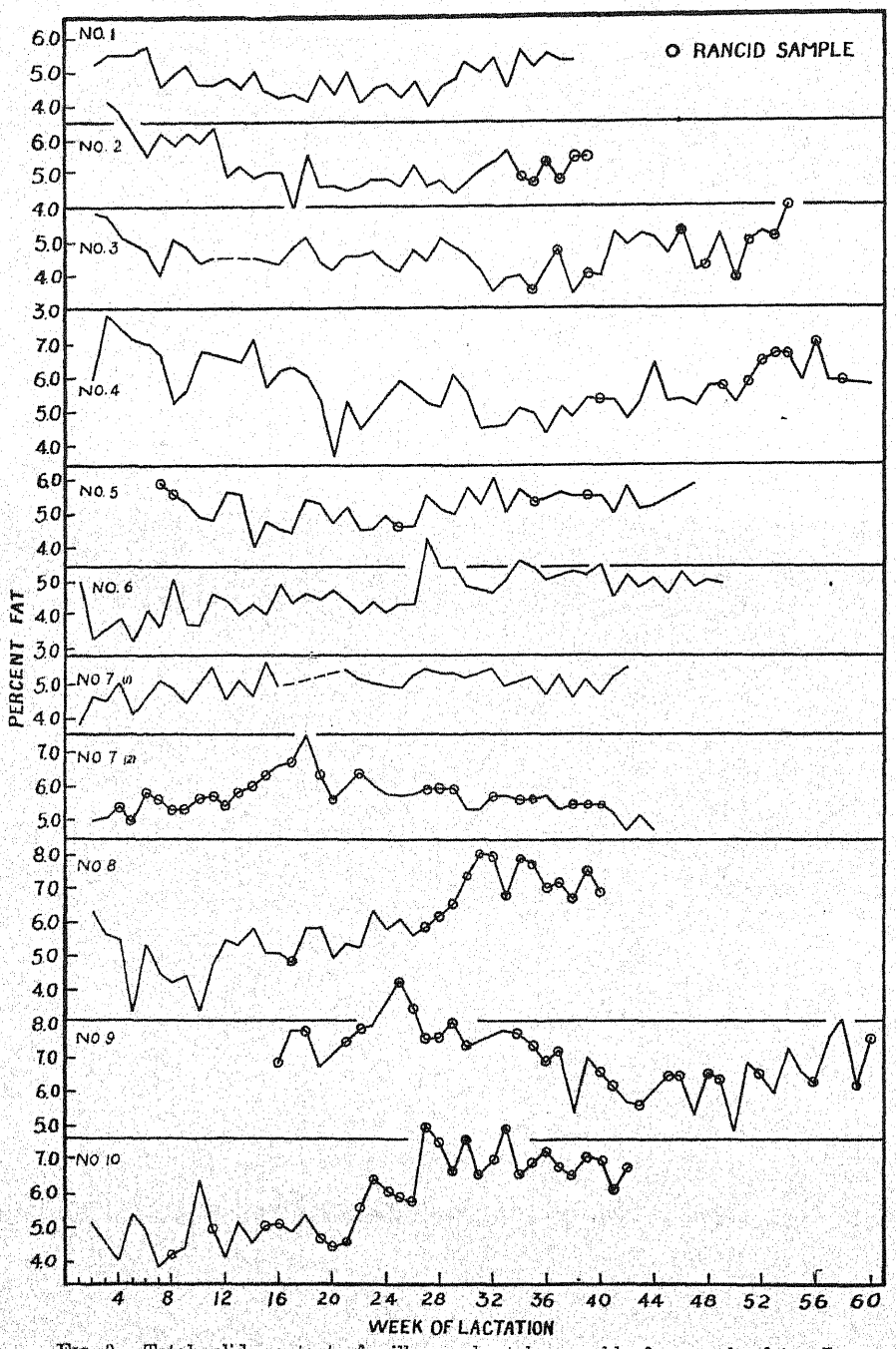

FIG. 3. Total solids content of milk samples taken weekly from each of ten Jersey cows during a complete lactation. Rancid samples are indicated by circles.

solids content of 677 normal samples irrespective of the period of lactation was 14.53 ± 0.0205 per cent, with standard deviation of ± 0.534 per cent and a 3.7 per cent coefficient of variation.

Total Solids Content of Rancid Milk

In Figure 3 the total solids content of rancid samples may be compared with that of non-rancid samples of the same lactation. As is shown in Table 1, the mean total solids content of rancid samples exceeded that of normal samples produced in a given lactation and the average total solids of all samples produced during a lactation was higher for animals that frequently produced rancid samples than for those that did not. The milk of animals 7, 8, 9 and 10, had an average total solids content of 15.29 per cent; that of animals 1, 6, and 7 (1) an average of 13.89 per cent. The average total solids for the milk of animal 7 during lactation 1 when no rancid samples were produced was 14.37 per cent, whereas in the succeeding lactation during which many rancid samples were produced, it rose to 15.34 per cent.

From Graph 2, Figure 2, it is evident that the total solids content of rancid samples was usually higher than the mean total solids content of normal samples produced during the same week of lactation. The average total solids content of 163 rancid samples was 15.35 ± 0.12 per cent; that of 672 normal samples 14.53 ± 0.02 per cent. The difference between the two values, 0.82 per cent, is 6.79 times the standard error of the difference, 0.1207 per cent, and is therefore significant.

Protein Content of Normal Jersey Milk

Determinations were made of the protein content of all samples collected over a period of about four months. A total of 290 samples were analyzed for total protein and of these, 77 samples were analyzed for casein and albumin.

Table 4 presents the average protein content of all normal samples for 12 successive four-week periods. The behavior of protein as lactation advanced was characterized by a decrease from 3.6 per cent in the first month to 3.3 per cent in the second month of lactation, followed by an increase lasting until the 7th month when the protein reached a value of 3.8 per cent which was maintained with little change until the 12th month. Twelve normal samples taken during the 16th to 18th periods were found to have an average protein content of 4.34 per cent. Except for the 4th and 5th months, variation in the protein of samples taken in the same period of lactation was small, the coefficients of variation ranging from 3.67 per cent to 9.21 per cent. There was also little variation in protein of samples from the same animal, the coefficients of variation for 14 individuals ranging from 5.6 to 8.3 per cent. The mean protein content of all normal samples was 3.60 ± 0.02 per cent, with a standard deviation of 0.36 per cent and a coefficient of variation of 9.92 per cent.

TABLE 4

Protein content of normal[1] Jersey milk in relation to the period of lactation

Lactation period	Milk samples	Protein content		
		Mean	Standard deviation	Coefficient of variation
weeks	*number*	*per cent*	*per cent*	*per cent*
1–4	19	3.63 ± 0.07[2]	0.32	8.8
5–8	37	3.33 ± 0.04	0.24	7.3
9–12	35	3.36 ± 0.04	0.23	6.7
13–16	32	3.54 ± 0.08	0.43	12.2
15–20	28	3.61 ± 0.08	0.43	11.9
21–24	23	3.67 ± 0.04	0.17	7.5
25–28	21	3.83 ± 0.07	0.33	8.7
29–32	15	3.76 ± 0.04	0.14	3.8
33–36	9	3.76 ± 0.06	0.18	4.9
37–40	11	3.83 ± 0.11	0.35	9.2
41–44	8	3.85 ± 0.07	0.20	5.1
45–48	6	3.75 ± 0.06	0.14	3.7

[1] No rancid samples are included.
[2] Standard error of mean.

Variations in the protein of milk observed in this study are, in general, in agreement with earlier findings. Nottbohm (4) in a study carried out with one animal observed that protein increased considerably during lactation, a sharp rise occurring after the 36th week. Van Slyke (6) found that the per cent protein dropped from 3.19 per cent in the first month to 2.99 per cent in the second, then began an increase which continued throughout during the entire lactation. The increase became more marked in the tenth and eleventh months. The maximum value observed was 4.04 per cent and was reached in the eleventh month. Eckles and Shaw (2) observed no drop in protein of Jersey milk between the first and second months, but they found that the protein increased after the second month from 3.32 to 4.91 per cent in the last period (56th week). They report an average of 3.64 per cent total protein for the complete lactations of three animals, as compared with 3.60 per cent the average value found for all normal samples in the present study.

Protein Content of Rancid Jersey Milk

During the period in which the protein content of milk was studied, 46 rancid samples were produced. Twelve rancid samples occurring in the first 16 weeks of lactation had a protein content ranging from 2.71 per cent to 3.91 per cent as compared with the normal range of from 3.33 per cent to 3.54 per cent for the same period. Thirty-four rancid samples occurred after the 28th week of lactation; of these, thirty-two had a higher protein content than did normal milk of the same period, the values ranging from 4.0 per cent to 5.32 per cent. The protein content of normal milk of the same period varied from 3.76 per cent to 3.85 per cent.

The average protein content of all rancid samples was 4.13 ± 0.096 per cent, standard deviation ± 0.6511 per cent and a coefficient of variation of 15.8 per cent. The standard error of the difference between the mean

TABLE 5

Total protein, casein and albumin content of normal and rancid Jersey milk

Description of samples	Milk samples	Total protein		Casein		Albumin		Casein	Albumin
		Mean	S. D.[1]	Mean	S. D.	Mean	S. D.[1]	Total protein	Total protein
	number	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*
Normal	67	3.68	0.559	2.88	0.54	0.35	0.06	78.75	9.41
Rancid	10	4.05	0.359	3.18	0.35	0.39	0.06	78.50	9.53

[1] Standard deviation of mean.

protein content of normal and rancid milk was ± 0.096 per cent; the difference was 0.53 per cent, which is 5.4 times the standard error of the difference and is therefore significant.

Protein Distribution in Normal and Rancid Jersey Milk

Since the total protein content of rancid milk was found generally to be higher than that of normal milk, it seemed desirable to determine whether the increased protein was due to an increase in one or all of the protein fractions. Determinations were made of the total protein, casein, and albumin content of 67 samples of normal milk and 10 samples of rancid milk. The results of these determinations are shown in Table 5. From these results it is evident that casein and albumin are present in the same proportion in rancid milk as in normal milk. One would conclude, therefore, that the increase in the total protein of the rancid samples is due to an increase in all the protein fractions rather than to an increase in any single one.

SUMMARY AND CONCLUSIONS

Data have been presented showing the fat, total solids and protein content of the milk of animals of a Jersey herd, all of which received the same ration and were subject to the same environmental conditions. The amounts of these constituents found in milk criticized as rancid have been compared with the amounts present in normal milk produced during the same period of lactation. The data are presented statistically and graphically both for individual animals and for the herd.

In general, rancid milk has a higher content of total solids, fat and protein than does normal milk of the same period of lactation. The increased protein content of rancid milk is attributed to an increase in the amounts of both the casein and lactalbumin fractions. The high content of these constituents appears to be characteristic of all milk produced by those animals whose milk is frequently rancid.

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INTERRELATIONS OF MILK-FAT, MILK-PROTEIN AND MILK-ENERGY YIELD

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This article grew out of an inquiry by the American Dairy Cattle Club. In the registration of dairy cattle the Club has taken the progressive step of requiring an estimate of milk-protein yield (in addition to the usual estimate of milk and milk-fat yield) of individual cows. The yield estimates are based on monthly tests covering the 3d–307th days of each lactation, or 305-day partial lactation system.

A recent article by Dr. Goodale (1), geneticist for the Club, represents that protein is the most valuable of all the milk components and that it is desirable, by breeding, to increase the ratio of protein yield to yield of other milk solids (comparable to increasing the proportion of high-priced cuts in meat animals).[1] A breeding program along this line requires a practical field test for protein. Pending the development of such a test the question arises as to the possibility of estimating protein yield from the milk and fat yield.

This question may be put in the form of the relation between fat percentage and protein percentage of the milk of individual cows. If we know the 305-day fat percentage for a given cow, how accurately can we estimate her corresponding protein percentage? The relation between fat and protein (as well as other milk components) for 3-day samples has been heretofore reported (2, 3). It is the purpose of this paper to apply the analyses of these 3-day samples to the appropriate milk yields to secure an estimate for individual cows for a partial lactation approximating the above 305-day period, and to present the interrelation between yields of various milk components, particularly milk fat, milk protein and milk energy.

DATA AND METHODS

The chemical analyses (2, 3) were made on 3-day composite samples of the milk of individual cows in the University of Illinois herd. For the most

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[1] This is a very free version of Goodale's paper, which in fact contains a mixture of legal, economic and biologic points, and unfortunately some misinformation as to milk composition. He states that as we pass from milk of 3 per cent fat to milk of 6 per cent fat the percentage of lactose increases from 4.0 to 4.4 and the percentage of ash increases from .6 to .9. Aside from the gross errors involved in his absolute lactose and ash values it is quite contrary to the well-known principle of osmotic equilibrium in milk secretion that lactose percentage and ash percentage should vary so markedly in the same direction. To maintain a constant osmotic pressure of milk (equal to that of the blood) it is inevitable that variations in lactose percentage and ash percentage will tend to be in opposite directions.

part the samples were taken at 5-week intervals, although there was some variation in this particular. The analysis of each sample included water, fat, protein (total nitrogen × 6.38), ash and lactose (lactose by difference). In all, 2426 samples were analyzed. Milk yield was determined by weighing each milking.

In the present use of these data the analyses of the first 7 to 11 samples of the lactation have been applied each to an appropriate portion of the continuous milk-yield records (the sample being at approximately the center of the milk-yield portion) to estimate the total milk, fat, protein, lactose, ash and water yield for a period approximating the 3rd–307th days of lactation. The actual length of period represented varies somewhat but is here referred to as 305 days. As thus defined, 305-day partial lactations were available for 130 cows, represented by a total of 1519 samples (out of the 2426 referred to above).

From these 305-day yields the average composition of the milk is derived and presented in Table 1, together with the identity of the cow, the number of samples, length of period represented and average milk yield per day for the period. In the table, 7 to 11 samples indicate a single partial lactation; 16 to 21 samples indicate two partial lactations combined as one; 27 to 32 samples indicate three partial lactations combined as one.

Milk energy is estimated from the equation (4), $E = 93.12f + 53.58p + 39.871 + 49.80a - .356w$, in which E is calories of milk energy per kilogram of milk, f is fat percentage, p is protein percentage, l is lactose percentage, a is ash percentage, and w is water percentage.[2]

RELATION BETWEEN FAT AND PROTEIN

The 305-day fat and protein percentage data of Table 1 are plotted in Figure 1. The correlation between the two is measured by the coefficient of correlation, $r = .755$. Protein is related to fat by the linear equation $p = 2.10 + .346f) \pm .085$, shown by the straight line of Figure 1.

From the standpoint of estimating an unknown 305-day protein percentage from a known 305-day fat percentage by the equation $p = 2.10 + .346f$ applied individually in a large population of cows, the present data indicate that the estimate would be correct within .085 either plus or minus for one-

[2] Since, by the method of analysis, $f + p + l + a + w = 100$, we have the algebraically equivalent equations:

$$
\begin{aligned}
E &= \pm\ 0 + 93.120f + 53.580p + 39.870l + 49.800a - .356w \\
&= +9312.0 \pm 0\ f - 39.540p - 53.250l - 43.320a - 93.476w \\
&= +5358.0 + 39.540f \pm 0\ p - 13.710l - 3.780a - 53.936w \\
&= +3987.0 + 53.250f + 13.710p \pm 0\ l + 9.930a - 40.226w \\
&= +4980.0 + 43.320f + 3.780p - 9.930l \pm 0\ a - 50.156w \\
&= -\ 35.6 + 93.476f + 53.936p + 40.226l + 50.156a \pm 0\ w
\end{aligned}
$$

As a matter of convenience in computation the last one of these equations was used in estimating E. In applying the equation f, p, l and a were used to three decimals instead of the two reported in Table 1.

TABLE 1

Composition of 305-day partial-lactation milk yields of 130 individual cows

Herd No.	Samples	Total period	Milk yield	Fat (f)	Protein (p)	Lactose (l)	Ash (a)	Water (w)	Energy per kg. milk
	No.	ds.	kg.	%	%	%	%	%	cal.
14 Ayrshire Cows									
135	18	595	8.4	3.32	3.13	4.48	.67	88.40	657
326	9	288	18.9	3.46	3.45	4.92	.66	87.51	704
304	9	322	10.6	3.94	3.39	4.52	.69	87.46	732
294	17	584	10.5	3.96	3.65	5.07	.68	86.64	770
74	7	245	11.0	4.00	3.09	4.51	.70	87.70	722
342	9	315	8.7	4.00	3.43	5.14	.68	86.75	763
224	18	645	14.2	4.01	3.57	4.81	.69	86.92	760
354	9	308	8.2	4.18	3.30	4.85	.65	87.02	761
320	9	308	6.1	4.19	3.54	4.56	.67	87.04	764
350	9	315	5.5	4.21	3.49	4.64	.66	87.00	766
321	8	273	7.0	4.37	3.73	4.91	.67	86.32	805
323	18	610	7.9	4.38	3.64	4.91	.70	86.37	802
348	7	245	4.8	4.60	3.65	4.65	.71	86.39	814
351	9	308	7.8	4.96	3.67	5.28	.69	85.40	872
17 Brown Swiss Cows									
510	10	280	18.6	3.38	3.33	5.34	.71	87.24	710
479	10	280	15.3	3.44	3.44	5.02	.75	87.35	711
374	21	602	21.5	3.45	3.17	4.94	.71	87.73	692
499	9	252	12.5	3.50	3.61	5.23	.75	86.91	734
426	19	532	14.8	3.51	3.41	5.10	.69	87.29	717
394	29	826	27.8	3.54	3.37	5.11	.72	87.26	719
427	30	833	21.7	3.62	3.05	5.25	.69	87.39	714
435	20	560	24.4	3.63	3.38	5.19	.71	87.09	730
376	10	287	17.2	3.69	3.39	4.86	.70	87.36	722
393	20	574	13.4	3.90	3.21	5.00	.68	87.21	737
395	10	280	16.2	3.90	3.32	5.37	.69	86.72	759
475	21	581	11.6	3.96	3.44	5.09	.73	86.78	762
404	20	553	9.7	3.99	3.46	5.10	.73	86.72	765
439	32	875	16.2	3.99	3.48	4.99	.74	86.80	763
445	20	559	18.7	4.18	3.51	5.14	.73	86.44	788
401	10	280	18.9	4.28	3.55	5.30	.71	86.16	805
480	11	301	14.3	4.35	3.96	5.00	.78	85.91	824
14 Guernsey Cows									
262	9	309	15.9	4.43	3.40	5.01	.71	86.45	798
284	9	308	16.5	4.49	3.42	5.14	.68	86.27	809
335	9	301	18.4	4.59	3.52	4.94	.73	86.22	818
303	18	631	8.2	4.69	3.64	5.03	.75	85.89	839
282	10	330	10.2	4.72	3.57	5.18	.71	85.82	842
300	18	617	8.1	4.82	3.89	4.99	.74	85.56	863
297	9	309	18.1	4.82	3.83	5.07	.74	85.54	863
271	9	315	7.7	4.86	3.97	5.06	.75	85.36	873
272	10	315	9.7	4.89	3.63	4.97	.69	85.82	852
331	9	301	9.4	5.23	4.06	4.89	.76	85.06	907
267	18	644	7.6	5.27	4.25	4.84	.79	84.85	920
301	19	641	7.6	5.31	4.13	4.94	.77	84.85	921
315	9	308	10.1	5.54	3.89	5.06	.73	84.78	932
270	27	926	8.3	5.74	4.16	4.93	.76	84.41	962

TABLE 1—(*Continued*)

Herd No.	Samples	Total period	Milk yield	Fat (f)	Protein (p)	Lactose (l)	Ash (a)	Water (w)	Energy per kg. milk
	No.	ds.	kg.	%	%	%	%	%	cal.
15 Holstein Cows									
302	9	315	22.7	2.92	3.13	5.10	.65	88.20	644
273	8	308	21.4	3.02	2.99	4.96	.63	88.40	639
254	9	315	28.7	3.04	3.03	4.63	.68	88.62	633
288	9	315	22.7	3.09	3.31	5.11	.66	87.83	671
325	9	295	21.4	3.16	3.46	5.15	.67	87.56	687
263	9	315	29.2	3.19	3.05	4.56	.66	88.54	644
251	9	315	20.5	3.24	2.97	4.82	.67	88.30	654
324	9	302	24.7	3.31	3.25	5.12	.65	87.67	687
200	9	315	17.1	3.36	3.09	4.46	.67	88.42	658
298	19	630	19.0	3.45	3.53	4.86	.70	87.46	708
295	9	315	16.7	3.46	3.38	4.89	.71	87.56	702
322	9	309	18.2	3.50	3.61	5.01	.70	87.18	723
250	8	280	15.5	3.62	3.08	4.92	.67	87.71	700
257	17	624	20.9	3.65	3.29	5.00	.67	87.39	718
296	9	315	13.8	3.67	3.73	4.96	.71	86.93	744
13 Jersey Cows									
333	9	296	18.3	4.37	3.36	4.92	.66	86.69	785
336	9	287	8.6	4.59	3.56	5.19	.69	85.97	829
305	9	312	11.9	4.61	3.59	4.99	.68	86.13	824
279	9	315	10.5	4.68	3.86	5.03	.69	85.74	847
341	9	315	9.6	4.79	3.63	5.32	.70	85.56	857
299	9	349	9.5	4.85	3.77	5.16	.69	85.53	863
313	17	588	11.7	5.00	3.79	4.85	.70	85.66	866
327	19	640	9.1	5.12	3.67	5.09	.68	85.44	880
334	9	308	11.5	5.21	3.88	5.21	.72	84.98	906
317	18	617	9.0	5.32	3.95	5.10	.73	84.90	916
314	9	315	14.0	5.45	4.22	4.89	.74	84.70	935
349	7	238	4.8	5.95	4.12	4.95	.78	84.20	981
347	8	273	4.1	6.00	4.14	5.07	.69	84.10	987
21 Guernsey-Holstein F_1 Cows									
683	9	315	10.4	3.64	3.38	4.68	.73	87.57	712
671	27	938	15.0	3.69	3.42	4.96	.71	87.22	728
665	9	308	17.5	3.81	3.31	4.87	.70	87.31	730
655	9	308	12.8	3.85	3.66	4.78	.77	86.94	752
657	9	301	8.8	3.88	3.45	4.91	.72	87.04	747
663	18	618	16.4	3.93	3.44	4.91	.72	87.00	751
666	9	315	11.0	4.04	3.50	4.77	.76	86.93	760
690	9	301	6.8	4.07	3.66	4.87	.72	86.68	774
680	9	315	10.6	4.13	3.90	5.06	.71	86.20	800
689	9	294	11.5	4.13	3.96	5.28	.73	85.90	814
674	9	308	11.1	4.16	3.82	5.02	.75	86.25	799
673	9	315	16.5	4.19	3.20	5.05	.70	86.86	766
651	9	303	8.5	4.26	3.60	4.68	.71	86.75	781
667	9	308	13.2	4.36	4.06	4.89	.73	85.96	825
668	8	280	10.2	4.37	3.97	4.56	.79	86.31	810
653	7	245	4.9	4.40	4.23	4.53	.78	86.06	825
661	9	301	14.5	4.44	3.45	5.05	.70	86.36	803
688	18	610	10.9	4.75	3.80	5.07	.75	85.63	855
670	19	631	11.2	4.78	3.78	5.02	.73	85.69	854
654	10	315	14.9	4.83	4.01	4.65	.73	85.78	856
659	9	308	11.1	4.93	3.62	5.21	.67	85.57	864

TABLE 1—(*Concluded*)

Herd No.	Samples	Total period	Milk yield	Fat (f)	Protein (p)	Lactose (l)	Ash (a)	Water (w)	Energy per kg. milk
	No.	ds.	kg.	%	%	%	%	%	cal.
25 Guernsey-Holstein F_2 Cows									
723	19	617	9.6	3.66	3.52	4.91	.69	87.22	728
729	9	308	13.3	3.87	3.18	5.15	.66	87.14	738
739	16	553	9.5	3.88	3.33	5.15	.74	86.90	751
738	10	322	8.5	3.89	3.35	4.81	.70	87.25	736
702	10	316	11.9	3.94	3.39	4.69	.72	87.26	740
713	9	315	8.3	3.98	3.53	4.74	.75	87.00	755
736	8	245	10.9	4.04	3.35	4.97	.72	86.92	759
707	9	301	14.3	4.04	3.57	5.15	.69	86.55	776
732	9	308	8.4	4.21	3.63	4.92	.70	86.54	787
705	9	302	12.6	4.22	3.77	5.21	.70	86.10	807
710	7	238	8.1	4.26	3.60	4.64	.75	86.75	781
714	9	308	10.6	4.29	3.83	5.01	.76	86.11	811
730	9	301	11.4	4.38	3.43	4.99	.73	86.47	796
735	10	299	7.4	4.39	3.58	5.05	.70	86.28	806
711	9	309	10.2	4.42	3.55	4.83	.73	86.47	800
724	18	631	10.4	4.43	3.70	5.01	.71	86.15	815
737	9	308	10.2	4.46	3.26	5.08	.69	86.51	797
715	9	309	7.1	4.53	3.93	4.98	.71	85.85	836
728	9	301	10.6	4.55	3.54	5.07	.70	86.14	819
742	9	315	10.4	4.64	3.34	5.25	.77	86.00	828
725	10	308	11.1	4.64	3.64	5.18	.70	85.84	837
726	9	301	11.6	4.69	3.56	5.05	.71	85.99	833
720	9	296	10.5	4.74	3.68	4.99	.70	85.89	842
716	9	302	6.4	4.83	4.13	4.40	.70	85.94	851
734	8	280	11.1	5.23	3.54	4.96	.74	85.53	881
11 Guernsey-Holstein Back-Cross Cows									
806	9	315	10.3	3.26	3.11	5.05	.64	87.94	673
807	9	322	11.2	3.34	3.19	5.11	.68	87.68	688
804	9	315	12.5	3.41	3.22	5.16	.71	87.50	700
801	18	657	11.7	3.43	3.28	5.06	.70	87.53	701
805	9	315	10.5	3.50	3.30	5.32	.68	87.20	718
648	7	259	13.4	3.77	3.50	4.71	.69	87.33	730
802	7	231	8.9	3.91	3.26	4.92	.68	87.23	738
644	9	322	9.9	4.00	3.56	5.31	.67	86.46	778
649	9	295	12.4	4.07	3.39	5.03	.75	86.76	768
803	9	319	11.1	4.48	3.26	5.02	.65	86.59	794
650	7	238	8.8	4.53	3.95	4.60	.78	86.14	825

half of the individuals, while for the other half it would be incorrect by more than .085 either plus or minus. If milk yield were constant at 10,000 pounds the corresponding "probable error" of estimate of 305-day protein yield would be 8.5 pounds. Considering a 305-day protein yield of 300 or 400 pounds it might seem good enough if the estimate is correct within 8 or 9 pounds for half of the individual cows, and correct within 25 or 30 pounds for any individual in the whole population. However, we do not know that the present lot of 130 cows is representative of dairy cows in general, and use of the equation is not recommended, except as an expedient to obtain a rough idea of protein yield.

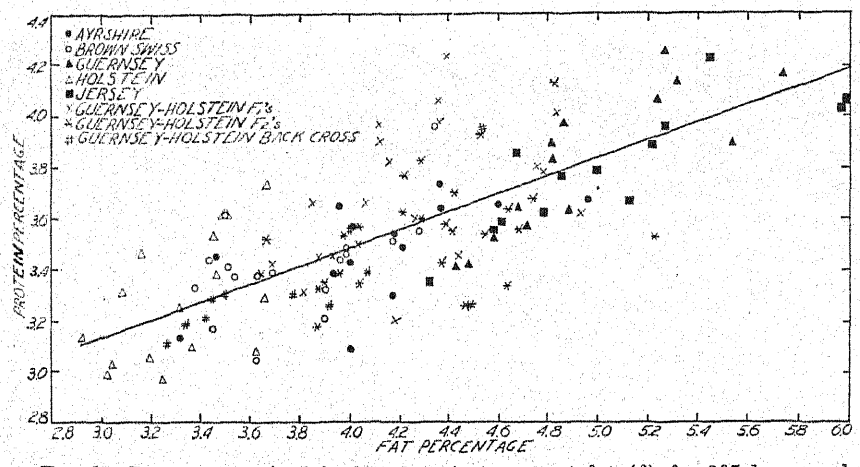

FIG. 1. Per cent protein (p) plotted against per cent fat (f) for 305-day samples of 130 cows. The correlation is r = .755, and the regression equation, represented by the straight line, p = 2.10 + .346f.

In Table 2 the protein-fat percentage equations are given by breed groups, both for the present 305-day samples and the earlier (mixed stages of lactation) 3-day samples. It may be noted from Table 2 that the 305-day protein

TABLE 2

Protein percentage according to breed and fat percentage

Breed	Protein percentage (p) as related to fat percentage (f)			
	3-day samples		305-day samples	
	Equation	p*	p*	Equation
Ayrshire	p = 2.061 + .366f	3.58	3.48	p = 2.257 + .298f
Brown Swiss	p = 1.509 + .523f	3.53	3.41	p = 2.091 + .350f
Guernsey (G)	p = 1.699 + .447f	4.02	3.81	p = .866 + .594f
Holstein (H)	p = 1.100 + .653f	3.42	3.26	p = 1.514 + .527f
Jersey	p = 2.402 + .282f	3.86	3.81	p = 1.590 + .438f
G–H F_1's			3.68	p = 2.112 + .371f
G–H F_2's			3.56	p = 2.481 + .249f
G–H Back Cross			3.36	p = 2.018 + .355f
G–H Cross Bred	p = 1.623 + .499f	3.80		

* At mean fat percentage for the breed.

percentage is lower than the corresponding 3-day protein percentage. As between the several breed groups the protein equations show considerable divergence, the greatest contrast being between the Guernsey, p = .866 + .594f, and the Guernsey-Holstein F_2's, p = 2.481 + .249f. The average of the eight 305-day breed equation constants gives p = 1.87 + .398f as compared with p = 2.10 + .346f for the 130 cows as a single group. In the general equation p = a + bf we are inclined to think it probable that b has a value of about .4, in spite of the fact that it works out at .346 in the particular case of these 130 cows.

RELATION BETWEEN FAT AND ENERGY

In Figure 2 milk energy per kilogram of milk is plotted against fat percentage. The correlation between fat percentage and calories for the 305-day samples of the 130 cows is r = .9847. The relation between these two is much

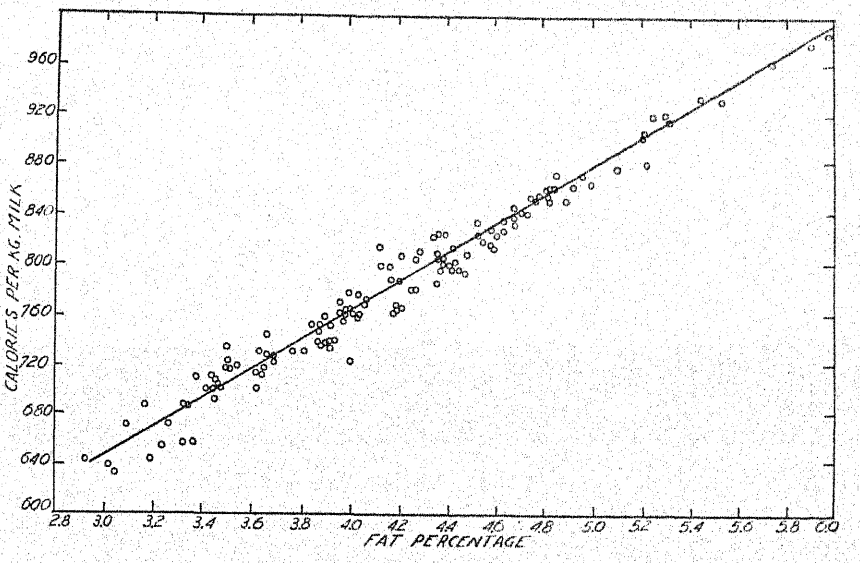

FIG. 2. Calories of milk energy per kilogram of milk (E) plotted against fat percentage (f) for 305-day samples of 130 cows. The correlation is r = .9847, and the regression equation, represented by the straight line, E = 304.8 + 114.1f.

closer than that between fat and protein per unit of milk (r = .755) which is natural since fat itself is a direct and dominating contributor to milk energy, while the connection between fat and protein is indirect.

The regression equation is E = 304.8 + 114.1f or E = 114.1 (2.671 + f). This compares with the equation previously found (4) from 1999 3-day samples (which did not include the Brown Swiss data) E = 115.33 (2.51 + f). It may be noted that the present 305-day formula agrees very closely with the estimate of milk energy in terms of 4-per cent milk by the formula .4 × milk + 15 × fat or 4-per cent milk proportional to $(2\frac{3}{4} + f)$. In terms of calories, however, the present equation gives 761 calories per kilogram of 4-per cent milk in comparison with 751 calories by the older (4) equation. It appears therefore that the formula for estimating 305-day energy yield in terms of 4-per cent milk needs no revision, but to convert a kilogram of 4-per cent milk by the .4M + 15F formula to calories for the 305-day period the factor 761 is indicated, instead of the factor 751 as found from the 3-day samples at mixed stages of lactation.

RELATION BETWEEN PROTEIN AND ENERGY

In Figure 3 milk energy per kilogram of milk is plotted against protein percentage. The correlation between protein percentage and calories for the 305-day samples of the 130 cows is r = .832. The relation between these two is not as close as that between fat percentage and calories (r = .9847) which

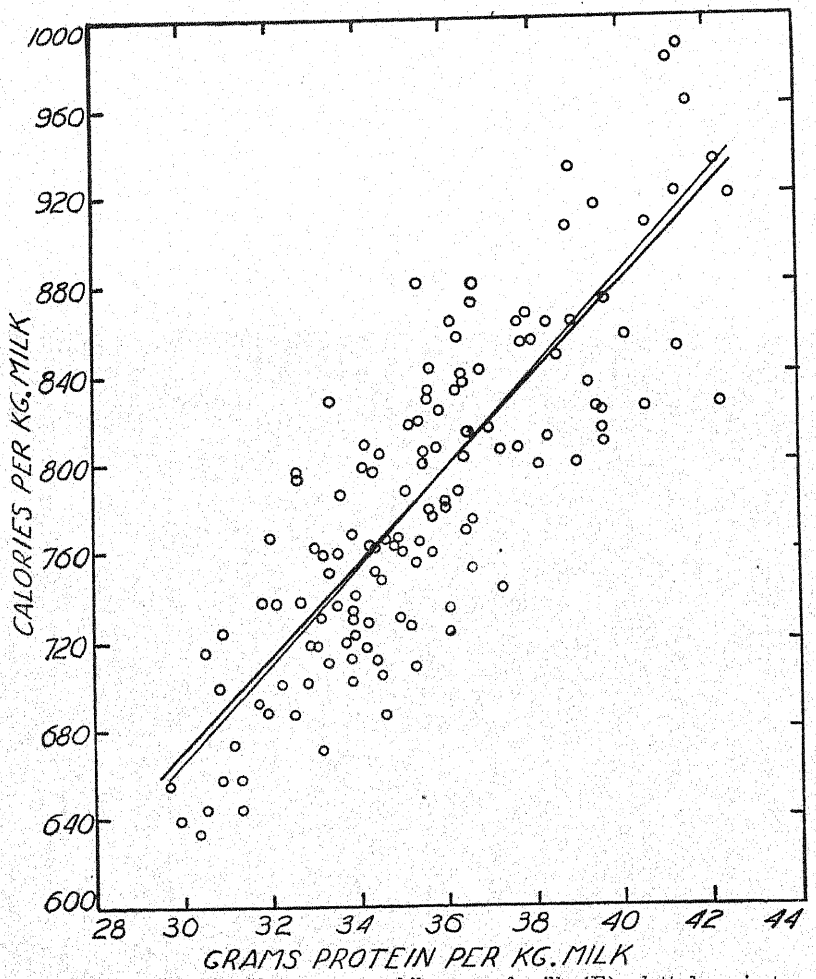

FIG. 3. Calories of milk energy per kilogram of milk (E) plotted against grams protein per kilogram of milk (P) for 305-day samples of 130 cows. The correlation is r = .832, and the regression equation represented by the heavy straight line, E = 37.8 + 21.0P. The light straight line represents the equation E = 22.6P, derived from the means of E and P alone.

may be a reflection of the fact that the protein itself is a smaller contributor to the milk energy than is the fat itself.

The expression of milk energy as a function of the protein (P) of the milk is given in Figure 3 by two equations: $E = 37.8 + 21.0P$ and $E = 22.6P$. The first is the usual least-squares linear regression equation, $y = a + bx$; the second eliminates the a constant or is simply $y = bx$ adjusted by least squares, that is, $b =$ mean of x divided by the mean of y. As may be seen from the plot of Figure 3 there is a very little difference in the accuracy with which the two equations represent the observations. In a gross way fat and energy are more closely related; but in a finer way protein and energy may be more closely related, if one is a simple multiple of the other.

The simple-multiple relation of protein and energy provokes speculation as to the nature of the relationship. If we may say that milk-protein yield is proportional to the nitrogen metabolism of the mammary gland in lactation, and milk-energy yield, to its energy metabolism, then we may advance the thought that the functioning of the gland, as measured by its total energy transformations, is geared to and dependent upon a mechanism of protein growth. This conception fits into the old (discredited) theory that milk formation is accomplished by a process of cell multiplication and disintegration. It may more reasonably be taken to mean that the energy transformations of the milk secreting cell are dependent upon a mechanism of protein elaboration. (In this connection compare the work of Brody, Procter and Ashworth (5) showing that the "basal" energy transformations of various species of animals are proportional to their "basal" nitrogen metabolism.)

By the equation, energy metabolism of lactation = nitrogen metabolism of lactation × constant, we reach the conclusion that without nitrogen metabolism of the mammary gland lactation ceases. The milk of all mammals contains protein, so there is no particular instance of contradiction of this conclusion in nature. On the other hand we do have some particular cases (*e.g.*, the mare) in which the milk is nearly fat free, yet lactation proceeds undisturbed and presumably in accordance with the same protein-energy relation. Taking this fat-free milk as origin we may regard fat-rich milk as the product of the original fat-free mechanism plus an additional one (or acceleration of an original weak one) in which we have a simple multiple relation between fat, protein and energy. Again, we may say that a protein mechanism underlies the energy transformations that result in the formation of milk fat.

The milk-protein yield of dairy cows thus takes on a special significance. Furthermore, if we accept the generalization that, as between individual hard-working cows, milk-energy yield tends to be independent of milk composition, then we may deduce the generalization that milk-protein yield tends to be independent of milk composition. Commercially fat yield has been forced on our attention. Biologically it seems that protein yield is more deserving of attention than is fat yield. After all, however, we have the fortunate circumstance that the total work of lactation can be accurately

estimated empirically from the common determinations of milk and fat dictated by commercial necessity.

PROTEIN/CALORIE RATIO IN RELATION TO FAT PERCENTAGE

While the foregoing section has placed emphasis on a constant protein/calorie ratio this constancy is only approximate. On the basis of the 3-day samples the equations relating protein per calorie to fat percentage have been reported (4) and are here repeated in Table 3 together with the

TABLE 3

Protein colorie ratio according to breed and fat percentage (f)

Breed	P′ = Milligrams of protein per calorie of milk energy			
	3-day samples		305-day samples	
	Equation	P′*	P′*	Equation
Ayrshire	P′ = 56.29 − 2.32f	46.7	45.7	P′ = 58.92 − 3.22f
Brown Swiss			45.9	P′ = 54.77 − 2.34f
Guernsey (G)	P′ = 48.89 − .83f	44.6	43.7	P′ = 40.47 + .66f
Holstein (H)	P′ = 46.49 + .46f	48.1	47.9	P′ = 51.44 − 1.08f
Jersey	P′ = 55.59 − 2.32f	43.6	43.1	P′ = 47.01 − .78f
G–H F_1's			46.5	P′ = 55.35 − 2.09f
G–H F_2's			44.7	P′ = 57.23 − 2.90f
G–H Back Cross			46.3	P′ = 54.62 − 2.19f
G–H Cross Bred	P′ = 49.68 − .61f	47.0		

* At mean fat percentage for the breed.

corresponding equations for the present 305-day samples. In general as fat percentage increases protein per calorie tends to decrease slightly. In the 3-day samples the Holstein breed seemed to be an exception to the general rule. It is therefore of interest to note that in the 305-day samples the exception disappears, and it seems safe to say that for all breeds there is a slight tendency for the amount of protein per calorie to decrease with increase of fat percentage.

BREEDING TO ALTER THE PROPORTION OF PROTEIN

As above noted one object of the American Dairy Cattle Club is to promote the breeding of cows in which the milk protein constitutes a larger proportion of the total food value of the milk. Taking energy as a measure of the total food value of the milk, the object is to increase the protein/calorie ratio. From what has been said this object appears difficult, and perhaps in conflict with the principles of the life processes involved in milk secretion. Still, in Figure 3 it is seen that at a given value of calories per kilogram of milk there is a considerable range in the amount of protein per kilogram of milk. That is, the protein/calorie ratio varies to a certain extent as between the individual cows represented in the present 305-day records.

Of the present records 32 cows have two lactations represented. The correlation between the first and second lactations with respect to the protein/calorie ratio for these 32 cows is $r = .28 \pm .11$. A part of that correlation is associated with the fat percentage and if fat percentage is held

constant the partial correlation reduces to .18 ± .11. If individual differences between dairy cows in the protein/calorie ratio are no more stable than indicated by these low correlations any program of altering the protein/calorie ratio of the milk by selective breeding appears rather hopeless.

SUMMARY AND CONCLUSIONS

The data examined consist of the 305-day partial lactation yields of 130 cows with respect to milk fat, milk protein and milk energy. The yields were determined by continuous milk weights and complete chemical analysis of 3-day samples at 5-week intervals.

Where only the milk yield and fat yield are known milk energy yield may be estimated more accurately (r = .985) than can protein yield (r = .755). The accuracy of estimate of energy yield from milk and protein yield is intermediate (r = .832). These correlations are between actual and estimated yields, at a given milk yield.

While the correlation between fat percentage and energy per kilogram of milk is much higher (r = .985) than that between protein percentage and energy (r = .832) the protein-energy relation is regarded as the more significant biologically. This point of view is based on the fact that energy yield tends to be a simple multiple of protein yield. If there is no elaboration of milk protein there are no lactation energy transformations and there is no milk secretion. On the other hand, elaboration of milk fat may be zero without interrupting milk secretion. The elaboration of milk fat requires the elaboration of milk protein additional to that of fat-free milk secretion. In general, the total (and often enormous) energy transformations of milk secretion depend on and are proportioned to the elaboration of milk protein or nitrogen metabolism of the mammary gland in lactation.

According to the above interpretation it appears futile to try to modify the protein calorie ratio of milk by selective breeding. The protein calorie ratio has a low variability (C.V. = 5) and as between successive lactations of the same cow it shows a low correlation (r = .18). Hence, to increase the proportion of food value (calories) present in the milk as protein, by breeding, would be exceedingly difficult.

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THE pH OF BLUE OR AMERICAN ROQUEFORT CHEESE

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No data have been found in the literature relative to the pH of Blue or American Roquefort cheese. The only information, known by the authors prior to the data secured in this work concerning the pH of Blue cheese, was furnished by Hall (1). According to Hall's data, the pH of Blue cheese shortly after manufacture was 4.55. The pH dropped to a minimum at about pH 4.45 at the end of about 15 days. During the next 15 days there was a rapid decrease in the hydrogen ion concentration of the cheese to pH 4.70. The acidity decreased slowly but quite uniformly as the cheese aged. When the experiment was terminated at 290 days, the cheese was at pH 5.45.

In the course of other experimental work (2) the authors have determined the pH values on cheese from 60 different lots at intervals during the ripening period. The determinations were made daily for 16 days on the cheese from one group of 12 lots, then at intervals of 3 or 4 days until the 29th day, then weekly until the cheese were wrapped in foil on the 99th day, then again at 180 and 270 days. This group is identified as trial 4. The pH determinations were made on the cheese from the other lots at approximately 4, 40, 70, 100, 180 and 270 days.

The mean pH values for the 12 lots of cheese in trial 4 at the various periods are shown in chart 1. Also shown are the mean pH values for the

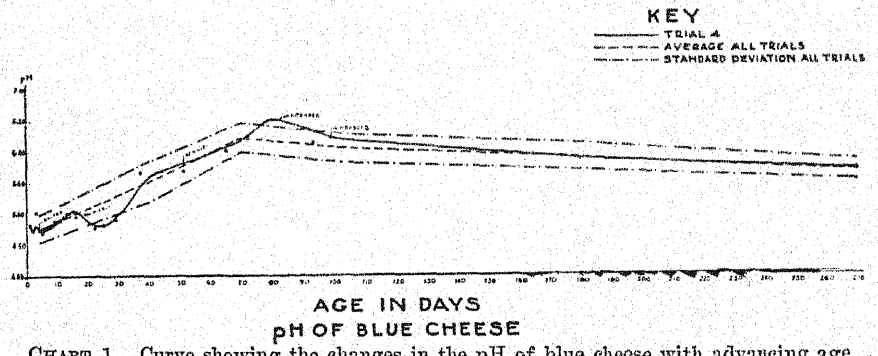

CHART 1. Curve showing the changes in the pH of blue cheese with advancing age.

cheese in all trials at the periods for which data are available. To indicate the variability of the data, the standard deviations of the pH values for the cheese in all the trials are shown.

The hydrogen ion concentration of the cheese appeared to reach a maximum at about pH 4.70 after about 24 hours. After salting, the pH increased

* The data in this paper are from a thesis presented by J. Spencer George in partial fulfillment of the requirements for the degree of M.S., University of Minnesota, Journal Series Paper 1579. Minnesota Agricultural Experiment Station.

rather rapidly until the cheese were pierced to admit air. The data from trial 4 indicate that following piercing, the pH dropped from about 5.0 to about 4.8, but after a few days, the acidity again decreased. The cheese in trial 4 were pierced on the 19th day at which time the mean pH was 5.01. On the 22nd day the mean pH was 4.77. This difference is statistically very significant, as the value of F (ratio of the greater to the lesser mean square) is 37.4. According to Snedecor (3) if the value of F for this number of observations is as great as 7.88 there is only one chance in one hundred that there is no real difference in the data. Every one of the twelve lots of cheese in trial 4 had a lower pH on the 22nd day than on the 19th day.

On the 79th day the mean pH of the cheese in trial 4 was 6.72. This was the maximum pH reached. A gradual re-acidification of the cheese occurred following this period. At 180 days the mean pH was 5.89, and at 270 days 5.72.

The mean pH values for the 60 lots of cheese in all trials followed much the same trend as the cheese in trial 4. The drop in pH following piercing is not evident in the data for all trials as the pH values were not determined between the 4th and the 40th days. The maximum pH recorded for the cheese in all trials was on the 70th day; however, the actual maximum was probably reached as in trial 4, sometime between the 70th and the 100th days.

The cheese in all trials showed the same trend in gradual re-acidification with advancing age as the cheese in trial 4. The mean pH on the 70th day was 6.24, on the 100th day 6.07, on the 180th day 5.91 and on the 270th day 5.69. The value of F in comparing the pH values of the cheese on the 70th day and on the 270th day is 9.68. A value of F as great as 6.84 for this number of observations indicates that there is less than one chance in one hundred that there is no real difference in the data.

SUMMARY AND CONCLUSIONS

1. The acidity of Blue cheese in these trials reached a maximum at about pH 4.7 within 24 hours after manufacture.

2. With the exception of a temporary increase in acidity following piercing, the acidity decreased gradually to about pH 6.5 at about the end of the third month.

3. After about the third month, the acidity of the cheese increased gradually to about pH 5.7 at the end of the ninth month when the experiment was terminated.

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A PLANT STUDY OF DAMAGED AND DEFECTIVE MILK BOTTLES

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In recent years much consideration has been given to the economic and practical importance of broken, damaged, and defective milk bottles. Kouwenhoven (1) reported the results of efforts to improve the resistance of bottles to chipping and recommended a group of tests for bottle quality control. Clement, Bain, and Grant (2) studied bottle breakage from the standpoint of plant design. They found that many bottles were discarded because of chipping and that wide and rapid changes in temperature were important factors in breakage. They concluded that bottle breakage in the plants studied depended to a large degree on the plant arrangement and the equipment used. Jones (3) and Antwerpen, Trebler, and Shrader (4) reported on the factors influencing bottle scratching and etching. Mohr (5) discussed the problem of bottle breakage and bottle loss. Dey (6) reported a plant study of bottle damage in which he concluded that defective new bottles, the washing operation, and improper handling in cases and crates were the chief causes of bottle damage.

These studies have been largely concerned with the effect of plant equipment and handling on bottle breakage. The present study was made to determine the character and source of the defects which render milk bottles unfit for use; the occurrence of defective bottles in the daily cycle of usage; and the relation of retail-wholesale sales distribution to the life of the bottles. Two large milk plants using bottles of different manufacture were selected for the study. About 50% of the quarts used in Plant B were Cream-top style. Plant A used the regular or "straight neck" style exclusively.

I. REJECTED DEFECTIVE BOTTLES

At each point in the plants where defective or broken bottles were picked out, cases were substituted for the cullet cans and the bottles were saved for examination. Paper bags were provided for bottles broken into several pieces. The locations of the bottle collection stations were as follows: (1) return-bottle receiving room, (2) washer inlet, (3) washer outlet, (4) bottle fillers, (5) case filling table, and (6) cold storage room. At the end of the day's operation the rejected bottles were moved to a convenient well-lighted place for a careful examination. A record was made for each bottle showing the bottle manufacturer's name, the year of manufacture, the type of bottle, and the defect which resulted in the rejection of the bottle. A careful study of the bottles resulted in a classification of defects as follows:

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1. *Impact shock*

Impact or mechanical shock damage is identified by the presence or remnant of a scar or shatter spot on the bottle at the point of impact. When the bottle is badly dismembered, as is frequently the case in this type of breakage, the edges of the glass fragments have a rippled or streaked surface which serves further to identify the type of breakage. Spalls and chips are a special form of impact shock breakage resulting from a sharp angular or glancing blow. The plane of fracture is across the surface and not through to the inner surface as in regular impact shock breakage. A spall is essentially a chip in which the flake of glass produced is not entirely severed and clings in place. Some spalls extend deep into the surface. Large spalls are commonly known as "butterflies." Chips and spalls are formed most readily on the peaked and rounded regions of bottles such as lips, shoulders, bottom rims, and bottom ridges. (See Fig. 1.)

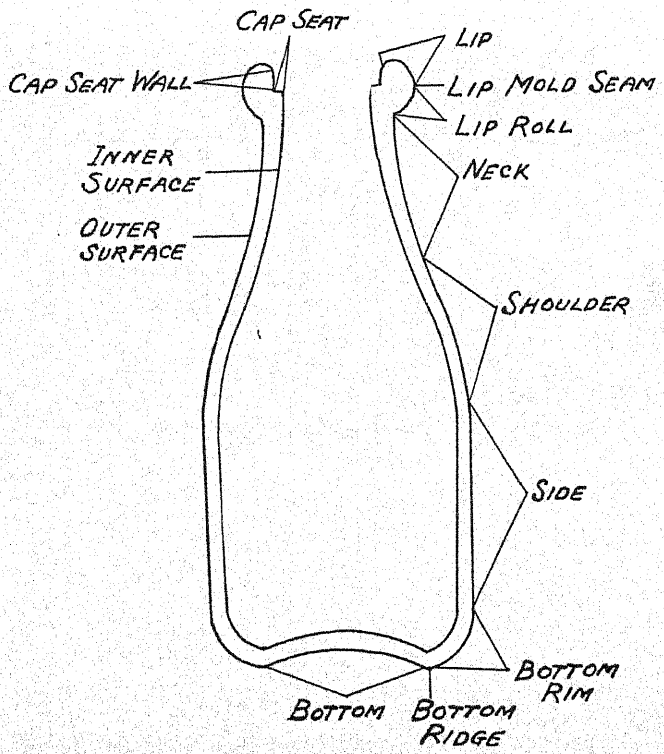

FIG. 1. Milk bottle nomenclature.

2. *Thermal shock*

Thermal shock cracks are non-ragged and curve smoothly. The edges of the glass severed by the crack are free from the ripples or grainy appearance

of impact cleavage. The ends of thermal shock cracks usually fade to a point of invisibility and under some conditions the cracks may appear to shorten and lengthen as the bottles are warmed and cooled. Thermal shock cracks do not always extend from outer to inner surface but may be in either surface and extend only partly through the glass. Fine, almost invisible, thermal shock cracks may require a sudden cooling effect such as cold milk at the filler to open them. Inhomogeneity of the glass composition or abnormal tensions on the bottle surface as a result of improper annealing reduces the bottle's resistance to the normal temperature changes in the washer and at the filler. It is these weakest bottles which crack first when the temperatures are not accurately controlled in the washer. Spalls, chips, and manufacturing flaws may act as nuclei for thermal shock cracks.

3. *Etching*

Etching of bottles is accumulative and results mainly from the continual rubbing together of bottles on the conveyors from washers to fillers. This defect is practically absent from bottles in plants where the bottles average less than 25 trips. Etched bottles are rejected because of their bad appearance.

4. *Manufacturing flaws*

Stones are opaque or transparent particles of foreign material in the glass mass. Bottles containing stones are rejected because of their bad appearance. Stones are usually surrounded by areas of improperly distributed compression or tension and act as nuclei for thermal or impact breakage.

Blisters are large air bubbles near the surface of the glass. Blistered bottles are rejected because of bad appearance and also because the thin wall of the blister is easily ruptured leaving sharp edges and a cavity.

Miscellaneous surface flaws are encountered sporadically in new bottles in significant numbers. They result from inefficient inspection at the glass factory. Bottles with such flaws are rejected because of their bad appearance and their susceptibility to breakage. Occasionally lop-sided or otherwise malformed bottles are encountered which present washing, filling, or capping difficulties and must be rejected.

DISCUSSION OF RESULTS

The damaged and rejected bottles of various sizes picked out at the two plants are classified in Table 1 according to the defect or damage which rendered them unfit for service. It will be seen that spalls and chips occurred most frequently around the lips and the bottom rims of bottles. Bottom ridges were chipped in the small bottles of Plant B largely because of faulty bottle design. In Plant A most of the impact cracking and breakage of the quart size was in the lip and neck. This is probably related to the large

TABLE 1

Classification of defects in rejected bottles

	No. rejected at Plant A (2 days)				No. rejected at Plant B (1 day)				
	Quart	*Pint*	*½ Pint*	*Gill*	*Quart*	*Quart**	*Pint*	*½ Pint*	*Gill*
Type of defect:									
A. Impact shock									
1. Spalled or chipped:									
(a) Lip and/or cap seat	174	10	52	20	97	45	100	82	21
(b) Shoulder	51	3	0	0	11	73	5	3	1
(c) Side wall	10	2	0	0	7	4	0	0	0
(d) Bottom rim	81	15	37	0	29	83	14	6	2
(e) Bottom ridge	0	0	0	0	0	0	6	22	2
2. Cracked or broken:									
(a) Lip and/or neck	212	11	48	71	24	12	15	65	23
(b) Shoulder	23	4	1	0	5	3	1	4	1
(c) Side wall	52	13	27	0	24	74	18	11	0
(d) Bottom rim	46	11	71	1	20	9	14	12	0
(e) Bottom	9	1	0	0	1	0	0	0	0
(f) Completely	114	3	30	9	34	20	21	4	1
B. Thermal shock									
1. Cracked:									
(a) Lip and/or neck	178	18	16	5	9	33	10	27	33
(b) Shoulder	1	0	0	0	0	0	0	0	0
(c) Side	30	1	9	0	7	3	4	5	0
(d) Bottom rim	4	2	0	0	2	2	0	1	0
(e) Bottom	8	1	1	0	0	0	0	0	0
(f) Mfg. flaw	9	1	0	0	0	0	0	0	0
(g) Completely	6	0	6	2	3	0	1	2	2
C. Etched surface	5	0	0	0	3	0	0	1	0
D. Mfg. defects:									
1. Blisters	3	0	1	0	2	2	1	0	0
2. Stones	3	0	0	0	3	6	2	0	0
3. Flaws	18	1	2	0	4	6	3	0	0
Total No. rejected	1,037	97	301	108	285	375	215	245	86
Total No. washed and bottled	240,000	68,000	78,000	10,000	39,500	39,000	49,000	37,500	5,000
Per cent rejected	0.43	0.14	0.39	1.08	0.72	0.96	0.44	0.65	1.72

* Cream-top style.

number of thermal shock cracks in that region. A fine almost invisible thermal shock crack may break open as the result of an impact which in itself would not be sufficiently forceful to damage a perfect bottle. There were many thermal shock cracked quarts and pints at Plant A and many gills at Plant B. This was undoubtedly related to the quality of the bottles used, since each plant had the same kind of washing machines and practically the same temperatures were used.

The small bottles followed the general trend of breakage as shown by the quart bottles. Most of the impact shock damage was in the lip and bottom rim regions and most of the thermal shock damage was in the lip region. In both plants the gill bottles had the highest total rejection percentage. They were followed by quarts, ½ pints, and pints. The low rejection percentage of pints is attributed to their short life as indicated by their low numbers of "trips per bottle." (See Table III). The high rejection percentage of the gills can not be readily explained by the data available.

II. DEFECTIVE BOTTLES IN USE

In order to study the efficiency of the plant bottle inspection at Plant A and to determine if breakage was occurring in the plant, a special sampling was made at the following stations: (1) return-bottle conveyor; (2) at the bottle washer just after the last chlorine water spray; and (3) at the case conveyor entering the refrigerator. One bottle was picked from the same pocket in every sixth quart case at the conveyors, and one bottle was picked from the same place in every sixth row of the sixteen pocket wide quart bottle washer. This sampling provided approximately 1000 bottles representing each station. These bottles were carefully examined and the defects were noted and tabulated.

A summary of the principal defects found in the bottles at the three stations is shown in Table 2. It is interesting to follow the course of the defective bottles in the plant. Bottles defective as a result of impact shock were

TABLE 2

Defects in samples of quart bottles in Plant A

	Empty returned bottles		Bottles in washer		Filled bottles in refrigerator	
	No.	% of sample	No.	% of sample	No.	% of sample
Type of Defects:						
Impact shock	89	9.4	84	9.1	85	8.7
Thermal shock	8	0.8	13	1.5	9	0.9
Mfg. defects	12	1.2	10	1.1	16	1.6
All defects	109	11.4	107	11.7	110	11.2
Size of Sample	954	100.0	910	100.0	981	100.0

reduced in percentage by the rough inspection at the washer inlet. This included principally bottles with broken necks and sides. The inspection at the washer discharge and at the fillers reduced further the impact shock defects. This latter inspection removed some of the bottles with the largest spalls and chips. The thermal shock cracks were increased or opened up by the washing operation and were again reduced by the washer discharge and filler inspection. It appears from these data that impact shock damage occurs largely outside the plant, and thermal shock cracking occurs in the plant. The manufacturing defects seemed to increase as the bottles passed through the plant. This is an inaccuracy resulting from the fact that it is difficult to see some manufacturing defects, notably transparent stones, until the bottle is filled with milk. A significant fact is that most of the so-called "breakage" at various places in the plant does not necessarily occur at the point where the bottle happens to be picked out. One exception is the washer discharge inspection which removes the bottles seriously cracked by thermal shock in the washer.

III. RETAIL-WHOLESALE SALES DISTRIBUTION

In Table 3 is shown the approximate distribution of bottled products from Plants A and B to retail and wholesale sales in comparison with "trips

TABLE 3

Retail-wholesale sales distribution and "trips per bottle"

	Plant A			Plant B		
	Retail %	Wholesale %	Trips per bottle	Retail %	Wholesale %	Trips per bottle
Quarts	92	8	25.7	61	39	12.2
Pints	85	15	9.4	35	65	5.8
Half-pints	57	43*	12.2	8	92*	13.4
Gills	93	7	14.0	38	62	5.4
Weighted Average	87	13	17.2	52	48	8.9

* Includes schools.

per bottle." The data shown as "trips per bottle" were obtained by dividing the number of bottles of each size bottled per month by the number of new bottles of each size purchased per month. This was averaged for the period of 9 months prior to the examinations. There were no bottle deposits required in either case and therefore much bottle loss resulted from the wholesale distribution. "Trips per bottle" is largely dependent on bottle loss outside the plant. It should be noted that school sales are included in the wholesale group. It is a large proportion of the total half-pint sales. The bottle returns from schools are excellent.

SUMMARY

A study of the damaged and defective milk bottles and related data in two large bottling plants resulted in the following conclusions:

1. Bottles were rejected because of impact shock breakage and damages, thermal shock cracks, etched surface, and manufacturing flaws.

2. Spalls, chips, and impact breakage in general occurred most frequently around the lips and the bottom rims of bottle. Sharp edges on the bottles contributed materially to chipping and spalling. Thermal shock cracks occurred most frequently in the lip and neck region. A significant amount of thermal shock cracking occurred in the bottle washing operation.

3. The rejection percentages were in the increasing order: pints, ½ pints, quarts and gills. There was some relation between low rejection and few "trips per bottle." Large percentages of wholesale distribution without bottle deposit were accompanied by few "trips per bottle."

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A DIAGRAMMATIC METHOD OF PRESENTING THE HISTORY OF REPRODUCTION IN A DAIRY HERD

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For many years agricultural colleges and experiment stations have recommended the improvement of feeding methods, the elimination of low-producing cows, and the proper selection of breeding stock. Although this program has resulted in more efficient dairy production, there is still room for considerable improvement.

Low production is responsible for only a small percentage of the total number of cows culled. Many are disposed of each year for other reasons, among which sterility and shy-breeding probably stand out as highly important factors responsible for the large number of replacements required annually in the average herd.

Many cows of great potential producing ability are slaughtered and their desirable effects on the herds lost because of their failure to reproduce. The search for superior germ plasm will improve the dairy cow population but little unless such excellent animals can reproduce normally over a period of years.

In studying[1] the causes of low efficiency of reproduction, we wondered whether certain types of reproductive failure might be diagnosed directly from a study of the breeding and calving records. In the literature, however, we have been unable to find a satisfactory method of analyzing such data. This paper will therefore present a diagrammatic method of assembling breeding data for analysis.

A comprehensive survey of the breeding efficiency of a dairy herd naturally requires, first, a complete and accurate daily recording of all breedings, calvings, and veterinary examinations on an easily accessible form. Breeders commonly enter such data in a hip-pocket note book, listing the services and calvings in chronological order. A few use a method resembling that shown in figure 1. The card, measuring $19\frac{1}{2} \times 17\frac{1}{2}$ inches, will take care of a 40-cow herd. The animals are listed by number in order of age—oldest to youngest. Provision having been made for two calvings, the card need not be renewed oftener than once each year. When any cow has calved twice, a new card is made out, and the cows are again listed in the original order. At birth, heifers are numbered and entered immediately in the proper column. Dates of disposal or purchase are also entered, to the right of the cow number.

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[1] The experimental work reported in this paper became cooperative with the United States Bureau of Animal Industry on February 1, 1937.

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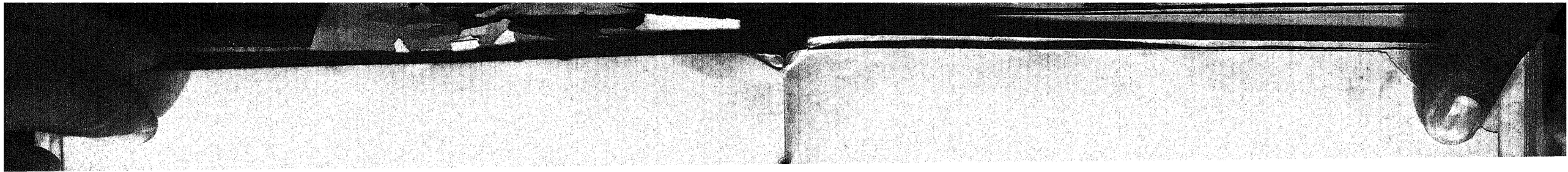


UNIVERSITY OF CALIFORNIA—BRANCH OF THE COLLEGE OF AGRICULTURE, DAVIS—DIVISION OF ANIMAL HUSBANDRY

BREEDING AND CALVING SCHEDULE

DATE FROM _____ TO _____

COW NO.	DATE OF BIRTH	DATE OF LAST CALVING	DATE TO BREED	BULL TO USE	BREEDING DATES	DATE DUE	DATE CALVED	NO. SEX AND WEIGHT	DATE TO BREED	BULL TO USE	BREEDING DATES	DATE DUE	DATE CALVED	NO. SEX AND WEIGHT

Fig. 1. A convenient form for recording breeding and calving data.

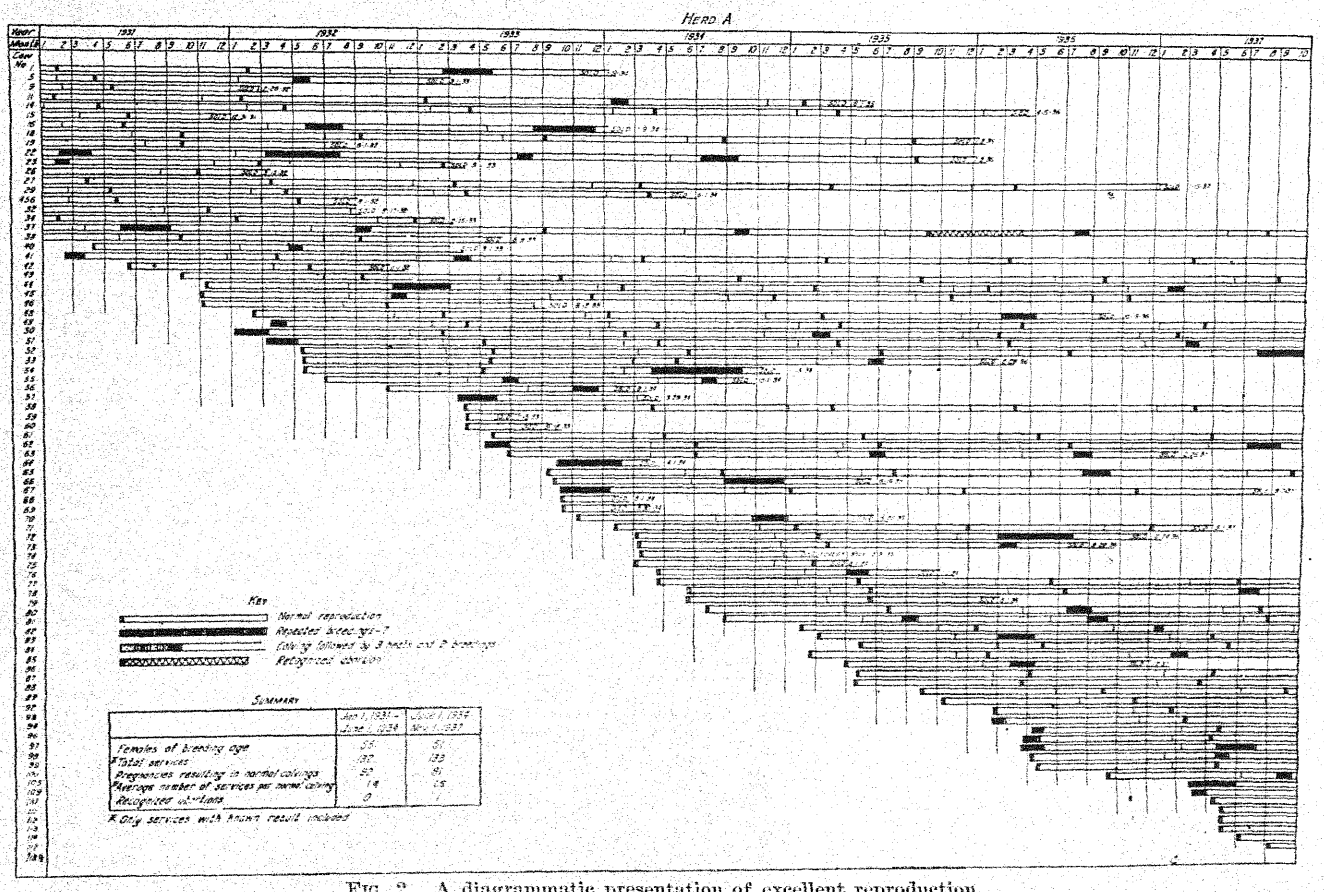


Fig. 2. A diagrammatic presentation of excellent reproduction.

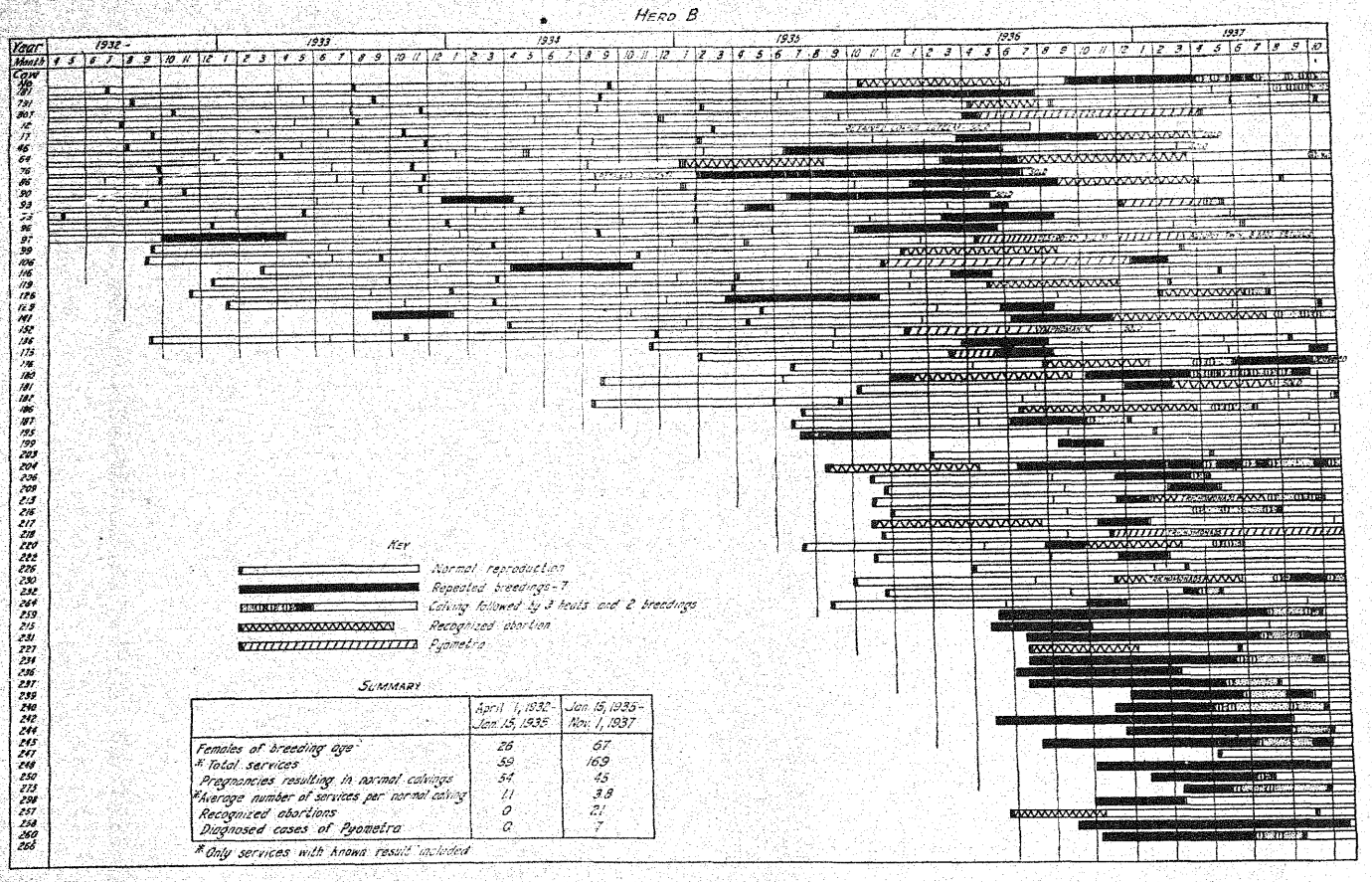


FIG. 3. A diagrammatic representation of efficient reproduction over a period of approximately three years, followed by reproductive failure as a result of Trichomoniasis.

Hence the card serves as an inventory as well as a breeding and calving record. This system has been used in the college herd for fourteen years and by a number of dairymen cooperating with the university in an experimental bull association for ten years. The data when recorded in this manner are readily accessible for analysis.

It is hard to obtain an intelligible picture of the efficiency of reproduction merely through an assemblage of breeding and calving dates. Such data have little meaning when published in tabular form. Figures 2 and 3 attempt to present diagrammatically the histories of reproduction in two California dairy herds.

The former depicts reasonably high efficiency of reproduction, over a period of slightly less than seven years; the latter, normal reproduction for the first 34 months followed by a period of decidedly poor reproduction. The long intervals between breedings, the occurrence of abortions in a herd negative to the agglutination test, and the many cases of pyometra present a typical picture of Trichomoniasis as the probable cause, later verified by actual identification[2] of the organism *Trichomonas fetus* (Riedmiller). After this diagnosis, which took place in March of 1937, the chart shows one phase of the disease-elimination measure—the recording of heat periods.

The diagrammatic method of presenting breeding data is flexible and may be adapted to a number of different types of such data. Reports of veterinary examinations are desirable and often essential. Where more than one sire is in use at a time, identification on the chart may be valuable.

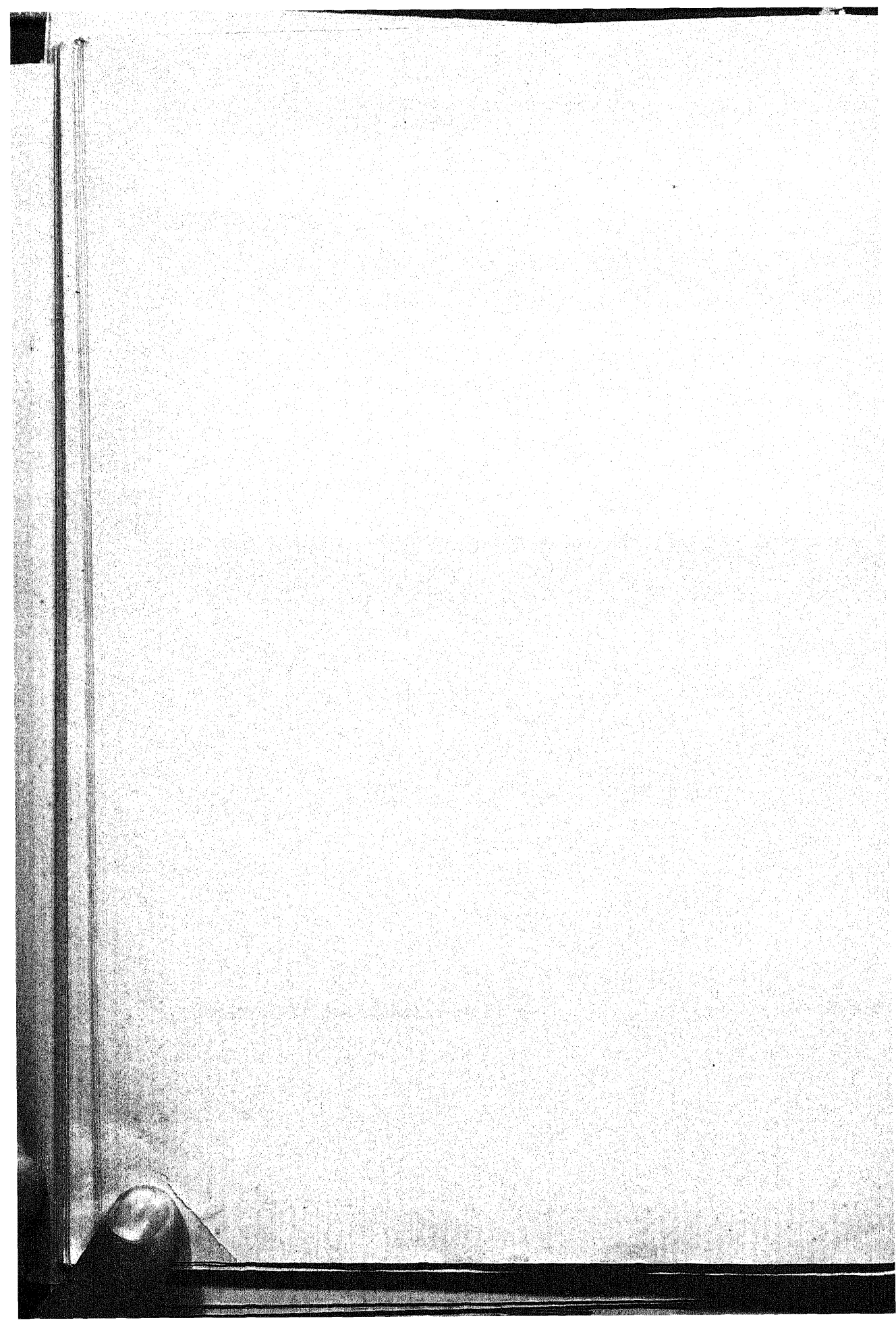
A summary of the data recorded in the diagram is not always necessary, since one may obtain a fairly accurate picture of the situation at a glance. Should such a summary be needed, however, the method used will depend upon the viewpoint and the desired result.

SUMMARY

A diagrammatic method of showing the history of reproduction in dairy herds is presented. The advantages of this method are as follows:

1. The reproductive history of the entire herd, over a long period, may be seen at a glance.
2. The individual performance of each animal can be easily followed.
3. Frequent recordings of data on the chart permit an early diagnosis of abnormal reproduction.
4. The method greatly facilitates the analysis of the data from various angles.

[2] This verification was made by Dr. H. S. Cameron in the Division of Veterinary Science.



COMPARISON OF TRYPTONE-GLUCOSE-SKIMMILK AND STANDARD NUTRIENT AGARS AS MEDIA FOR DETERMINING THE BACTERIAL COUNT IN ICE CREAM[1]

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Tryptone-glucose-skimmilk agar has been proposed as a more suitable medium than standard nutrient agar for making total bacterial counts on ice cream and milk. What effect the new medium will have on bacterial counts is of vital interest to the ice cream manufacturer who may be required to meet standards which were adopted on the basis of standard agar counts.

A study of 192 samples of commercial ice cream was made by Babel[2] in which he compared standard agar, standard agar plus sucrose, and tryptone agar. He reported that the tryptone agar gave higher total counts for ice cream than did either of the other two agars. The average logarithmic count for all samples on the standard agar was 43,160 and on the tryptone agar, 108,400, or an increase of 151 per cent. The greatest percentage increase was recorded for the low count samples. Babel noted that 28 of the 192 samples gave lower counts on tryptone agar than on standard agar, 83 gave increases of less than 100 per cent, and 81 showed increases of over 100 per cent.

Another comprehensive comparison of the two media was made by Robertson,[3] in which counts on 412 samples of ice cream were made by five different ice cream companies using the standard agar and tryptone agar at incubation temperatures of 32° C. and 37° C.

The logarithmic average of the bacterial counts obtained on standard agar plates incubated at 32° C. was 137 per cent of the counts obtained at 37° C. The average bacterial counts when tryptone agar was incubated at 37° C. and 32° C. were 116 and 154 per cent, respectively, of the counts made with standard agar. Robertson's study was conducted on ice creams with relatively low bacterial counts.

In the study here recorded, 279 samples of commercial vanilla ice cream were analyzed. The samples were collected by the State Dairy Commissioner of Kansas from licensed manufacturers located throughout the state. Prac-

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[1] Contribution No. *173,* Department of Bacteriology and No. *121,* Department of Dairy Husbandry.

[2] Babel, F. J. Significance of Laboratory Tests in the Control of Ice Cream. Ice Cream Trade Journal, 32, 9, 35. Sept., 1936.

[3] Robertson, A. H. The New Proposed Procedure for Making Ice Cream Plate Counts. Report of Proceedings of 36th Annual Convention, Int. Ass'n of Ice Cream Mfgrs., Vol. 2, p. 132. Oct., 1936.

tically all the samples were pint size, factory-filled packages obtained from large wholesale plants, counter freezer operators, and small retail manufacturers. The samples were refrigerated with dry ice, and transported to the laboratory at Kansas State College where the bacterial counts were made. Three plates containing 1/100, 1/1,000, and 1/10,000 dilutions were poured with standard agar and incubated at 37° C. Six plates, two of each dilution, were prepared using tryptone agar, three of which were incubated at 37° C. and three at 32° C. Samples were replated which gave unsatisfactory counts, from the standpoint of number of colonies per plate or discrepancies in counts from the three dilutions.

In Table I the bacterial counts obtained are classified into groups on the basis of the total count on standard agar. The number and per cent of samples falling into each group are indicated. The logarithmic and arithmetic average counts obtained on standard agar have been arbitrarily assigned a value of 100 and counts obtained on tryptone agar at the two incubation temperatures are expressed as percentages of the standard count. The counts are well distributed over a wide range with 57 per cent falling below 100,000 per ml. on standard agar incubated at 37° C.

The logarithmic average counts obtained upon tryptone agar incubated at 37° C. were from 125 to 169 per cent of those obtained on standard agar, the average for all samples being 137 per cent. At the 32° C. incubation temperature the counts varied between 154 and 200 per cent of the counts obtained on standard agar with an average of 192 per cent for all samples (Table I). The arithmetic average counts obtained upon tryptone agar incubated at 37° C. were 142 to 494 per cent of those obtained on standard agar, the average for all samples being 132 per cent. At the 32° incubation temperature the counts varied between 139 and 974 per cent of the counts obtained on standard agar, the average for all samples being 156 per cent (Table I).

As a convenient method of expressing the relationships of the counts, the ratios of the tryptone agar counts to the standard agar counts were calculated by dividing the tryptone agar count by the standard agar count. For example, a ratio of 2.0 would mean that the tryptone agar count was twice that of the standard agar count. These values are presented in Table II. In this table, the relationship of the counts obtained on the different media and at different incubation temperatures is indicated. Sixty-nine per cent of the tryptone agar counts at 37° C. were higher than the corresponding counts on standard agar, whereas at 32° C. 87 per cent of the samples showed higher counts. Comparison of the counts at 32° C. and 37° C. on tryptone agar show that 74 per cent of the samples gave higher counts at the lower temperature. The calculated ratios of tryptone agar counts to the standard agar counts are greater in every instance for the 32° C. temperature than they are at 37° C.

TABLE I

Relationship of tryptone-glucose-skimmilk agar counts to standard nutrient agar counts of 279 samples of ice cream

Range of plate counts	Number of samples	Per cent of samples	Logarithmic averages of standard agar counts (37° C.)	Tryptone agar counts per cent of standard agar counts		Arithmetic averages of standard agar counts (37° C.)	Tryptone agar counts per cent of standard agar counts	
				(37° C.)	(32° C.)		(37° C.)	(32° C.)
Less than 10,000	34	12.2	4,400	125	186	5,000	145	229
10,000–49,999	85	30.5	24,000	148	200	26,500	494	972
50,000–99,999	41	14.7	69,000	145	188	70,700	179	207
100,000–499,999	69	24.7	180,000	133	164	202,000	158	200
500,000–999,999	11	3.9	665,000	135	154	684,500	160	176
1 million to 10 million	25	9.0	2,950,000	169	200	3,652,000	217	276
10 million and over	14	5.0	45,000,000	160	164	100,974,000	142	139
Average all samples	279	100.0	96,500	137	192	5,490,000	132	156

TABLE II

Distribution of increases and decreases in count obtained with various media and incubation temperature combinations and the average ratio of counts for each group

Range of bacteria counts	Number of samples	Tryptone (37° C.) to standard (37° C.)			Tryptone (32° C.) to standard (37° C.)			Tryptone (32° C.) to tryptone (37° C.)			Ratio tryptone (32° C.) / standard (37° C.)	Ratio tryptone (37° C.) / standard (37° C.)
		Higher	Same	Lower	Higher	Same	Lower	Higher	Same	Lower		
Less than 10,000	34	22	2	10	30	3	1	29	1	4	2.2	1.4
10,000– 49,999	85	49	6	30	74	2	9	69	2	14	7.6	3.9
50,000– 99,999	41	33	2	6	38	0	3	30	3	8	2.1	2.0
100,000–499,999	69	51	1	17	61	0	8	49	2	18	2.2	1.8
500,000–999,999	11	6	0	5	9	0	2	9	1	1	1.8	1.7
1 million to 10 million	25	22	0	3	22	1	2	16	1	8	4.6	3.3
10 million and over	14	11	0	3	10	0	4	6	1	7	3.7	2.1
Total number of samples	279	194	11	74	244	6	29	208	11	60		

For the entire group of 279 samples the ratios of the tryptone agar counts at 32° C. to the standard agar counts at 37° C. ranged from 0.15 to 325.0 with an arithmetic mean ratio of 4.11, and a median or middle ratio of 1.52. When comparison was made of the ratio of tryptone agar incubated at 32° C. to that incubated at 37° C. it was found that the ratios ranged from 0.16 to 137.0 with an arithmetic mean ratio of 2.46 and a median of 1.25. The mean ratios are somewhat higher than would be expected due to the influence of a few extremely high ratios. The median ratio gives values which compare very closely with the arithmetic average counts. (These values were obtained from a study of all the assembled data and are not shown in the condensed table.)

DISCUSSION

It is evident from these data that the tryptone agar gave higher average counts at both 32° and 37° C. incubation temperatures in all the various ranges than did the standard agar at 37° C. This is in agreement with the results reported by other investigators except that the percentage increases are not as great as those obtained in other studies. The incubation temperature was an important factor in determining the count on tryptone agar. The change in incubation temperature from 37° C. to 32° C. produced a greater percentage increase in count than that affected by change in the medium. The logarithmic and arithmetic average counts for the various bacterial ranges were not noticeably different. In some of the comparisons which have been made the percentage increase was greater in the higher bacteria ranges than it was in the lower ranges. In this study no attempt was made to determine what type or types of organisms were responsible for the increased counts obtained on tryptone agar; however, a study is now in progress which may give some information on this point.

The ice cream manufacturer who has had difficulty in meeting present standards will be required to exercise even greater sanitary precautions in the manufacture of his product if the tryptone agar and 32° C. temperature are adopted.

SUMMARY

Bacterial counts have been made on 279 samples of commercial ice cream using standard nutrient agar and 37° C. incubation temperature and tryptone-glucose-skimmilk agar incubating the plates at 37° C. and 32° C.

The logarithmic average of the standard agar counts at 37° C. was 96,500 and the counts obtained on tryptone agar at 37° C. and 32° C. incubation temperatures were 137 and 192 per cent respectively of the standard agar count.

The arithmetic average of the standard agar count was 5,490,000 and the counts obtained on tryptone agar at 37° C. and 32° C. were 132 and 156 per cent respectively of the standard agar count.

The mean and median ratios of tryptone agar count at 32° C. to the standard agar count at 37° C. was 4.11 and 1.52 respectively.

The mean ratio of the tryptone agar count at 37° C. to the standard agar count at 37° C. was 2.46 and the median ratio was 1.25.

NOTE

Owing to the fact that this manuscript had been completed before the publication of an article entitled, "The Effect of Using Tryptone-Glucose-Skimmilk Agar and 32° C. Incubation on the Bacteria Count of Ice Cream," M. W. Yale and R. C. Hickey, JOURNAL OF DAIRY SCIENCE, XX, 12, Dec., 1937, it was not included in the review of literature.

THE OLD STORY OF TYPE AND PRODUCTION

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American Jersey Cattle Club, New York

The problem of type and production has been of paramount interest to breeders for generations. The importance of desirable conformation was recognized early by the breeders on the Island of Jersey when the first score card or scale of points was drawn up in 1834. It has also been more than fifty years since the first authenticated butter test was supervised by the American Jersey Cattle Club. During all of this time breeders have constantly striven to improve both the conformation and the producing ability of our dairy cattle.

In 1932, the American Jersey Cattle Club established the Jersey Herd Classification program providing for the inspection and rating of Jersey cows and bulls solely on the basis of conformation. The inspections are made by a group of judges approved by the American Jersey Cattle Club and the cattle are given one of six ratings depending upon their conformation, in relation to the scale of points of the Jersey breed. For instance, a cow to be rated as "Excellent" must be an animal which in the opinion of the official judge would score at least ninety or more on the official scale of points. A cow to be classified "Very Good," must in the opinion of the judge be entitled to a score of approximately eighty-five but less than ninety on the official scale of points. The next rating of "Good Plus" is given to animals scoring approximately eighty but less than eighty-five. The rating of "Good" is bestowed upon animals which in the opinion of the inspector would be entitled to a score of approximately seventy-five but less than eighty points. Cows which in the opinion of the judge are entitled to a score of approximately seventy but less than seventy-five points are rated as "Fair" and all animals which in the opinion of the judge would score less than seventy are rated as "Poor."

In applying for Herd Classification, the owner must submit every registered cow which he owns that has ever calved and all bulls fifteen months of age or older. No exceptions are permitted. The program has grown constantly in favor, since its adoption and to January 1st, 1938, a total of 4818 cows and bulls have been officially classified. The number is now large enough to provide some material for statistical analysis and the ratings and the records of these cows and bulls have been studied in the office of the American Jersey Cattle Club for the purpose of throwing further light on the still important question of type and production.

All of the animals classified have been divided into groups depending

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TABLE 1

Grouping of all animals classified according to age

		Under 2 yrs.	2	3	4	5	6	7	8	9	10	11	12 yrs. and over	Totals
Excellent	Cows	0	20	51	37	40	29	28	20	17	21	12	27	302
Excellent	Bulls	0	1	8	5	2	6	4	3	3	0	2	4	38
Very Good	Cows	0	120	171	142	119	89	65	69	71	53	37	47	983
Very Good	Bulls	31	20	19	17	21	6	12	6	3	4	1	7	147
Good Plus	Cows	6	284	373	290	241	169	128	85	46	44	27	40	1733
Good Plus	Bulls	49	34	17	21	14	9	14	2	8	3	1	2	174
Good	Cows	9	261	254	222	139	106	72	60	36	24	15	14	1212
Good	Bulls	30	16	4	6	4	6	3	1	1	1	0	2	74
Fair	Cows	4	35	39	14	15	10	5	8	3	2	3	4	142
Fair	Bulls	0	0	1	0	0	0	0	0	0	0	0	0	1
Poor	Cows	0	3	5	1	2	0	0	0	0	0	0	0	11
Poor	Bulls	1	0	0	0	0	0	0	0	0	0	0	0	1
Totals	Cows	19	723	893	706	556	403	298	242	173	144	94	132	4383
Totals	Bulls	111	71	49	49	41	27	33	12	15	8	4	15	435

upon the age at classification and on the ratings given. The results are shown in Table 1.

In examining this table, it will be noticed that there is a decided scarcity of animals in the lower two classification groups. This does not mean that all of the cows of the breed are superior to these lower classifications. However, it is a poor advertisement for any herd to be classified showing a considerable percentage of "Fair" and "Poor" cows. Consequently the usual practice in applying for classification is for the owner to cull the herd in advance and to dispose of the cows of inferior type before the inspection is conducted. As a matter of fact, this stimulant to culling is one of the advantages of the classification program and as a result when the judge arrives at the farm the cows of poor conformation have usually been sold. (It is hoped, to the butcher.)

It is interesting to note that fifty-one per cent of all cows classified as "Excellent" were past six years of age while in the "Good" classification only twenty-seven per cent were six years of age or older and only twenty-five per cent of the "Fair" cows were past six years of age. Apparently, the poorer type cows are soon weeded out of the herds, while the cows of good conformation are retained.

A considerable number of cows which have been classified have also completed official production records either in the Register of Merit or in the Herd Improvement Registry. The records of these cows have been tabulated and converted to a mature yearly equivalent basis using the A.J.C.C. conversion factors. Table 2 shows the records of all the cows that have been classified, grouped according to classification ratings and table 3 shows the same information on the cows classified during the calendar year 1937.

TABLE 2

Production records of all animals officially classified

Classification groups	Number of cows classified	Number of cows with R. of M. or or H.I.R. records	Per cent of cows with records	Average mature production of each group
Excellent	302	228	75.50	650.05
Very Good	983	649	66.09	624.03
Good Plus	1733	991	57.18	602.61
Good	1212	597	49.26	586.97
Fair	142	63	44.37	589.49
Poor	11	1	9.09	556.54
Totals	4383	2529	57.68	608.44

The information in the foregoing tables has been previously published based on a much smaller number of records and attention has been called to the relationship between the ratings of the animals and the production records. It will be observed in examining Table 2, that with the exception of the "Good" and "Fair" groups there is a gradual rise in the production

TABLE 3

Production records of all animals classified during 1937

Classification groups	Number of cows classified	Number of cows with R. of M. or or H.I.R. records	Per cent of cows with records	Average mature production of each group
Excellent	103	57	55.34	634.30
Very Good	379	169	44.59	619.47
Good Plus	649	237	36.52	588.67
Good	455	100	21.98	555.61
Fair	54	17	31.48	578.27
Poor	7	1	14.29	556.54
Totals	1647	581	32.49	596.06

as the classification ratings increase. This increase is not large, but it is very significant that a much greater percentage of the higher rating animals have production records than the lower rating animals. Undoubtedly if an equal percentage of each classification group had been tested the differences in production would be much more pronounced. This very fact makes a detailed analysis of the production records difficult. It seems safe to assume that in general, the animals tested represent the better producers within that group. There were forty-four per cent of the animals rated as "Fair" with production records. Table 4 was compiled on the basis of using records on just forty-four per cent of the cows in each classification group and selecting the cows with the highest records. For example, there were 302 cows classified as "Excellent." Forty-four per cent of this number is 133 and of the 228 "Excellent" cows with records, the high 133 were used and their records averaged. This table is obviously subject to considerable error but it does illustrate that if an equal percentage of each classification group had been tested, the differences in production would be much more pronounced than shown in Table 2 or 3.

TABLE 4

Hypothetical data showing average production when the number of records used is reduced to 44% of the number classified in each group

Classification groups	No. of cows classified	Per cent with records	No. of cows with records used	Average mature production of each group
		Per cent		*lbs.*
Excellent	302	44	133	723.41
Very Good	983	44	433	695.74
Good Plus	1733	44	763	654.75
Good	1212	44	533	613.48
Fair	142	44	63	589.49

It has been suggested that the range in production within each classification group exceeds the differences between the various groups and that therefore the relationship between classification ratings and production is not at

all significant. To determine the range in production of the animals tested in each classification group, the following frequency Table 5 was prepared.

TABLE 5

Frequency table showing distribution of records made by cows classified in various classification groups

Production divisions	Excellent	Very good	Good plus	Good	Fair
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Over 1000 lbs. of fat ...	0.88	1.69	0.91	0.68	1.59
900 to 999 lbs.	2.63	1.23	2.83	2.01	3.18
800 to 899 lbs.	7.01	7.41	6.26	3.02	3.18
700 to 799 lbs.	22.81	18.05	12.31	14.74	7.93
600 to 699 lbs.	31.14	25.62	24.82	22.28	25.40
500 to 599 lbs.	25.44	26.45	29.07	29.99	31.75
400 to 499 lbs.	8.33	16.05	17.86	19.26	17.46
300 to 399 lbs.	1.75	2.47	5.15	6.87	9.53
Below 300 lbs.	0	0.93	0.81	1.17	0

Examination of this table does illustrate that there is a wide range in producing ability within each classification group. Summarizing the results show that sixty-four per cent of the "Excellent" animals with records are above 600 pounds of fat, fifty-four per cent of the "Very Good" cows exceed 600 pounds, forty-seven per cent of the "Good Plus" cows exceed 600 pounds in production and forty-three per cent of the cows rated "Good" are over 600 pounds. Of the cows rated "Fair," about forty-one per cent exceed 600 pounds in production. However, the variation in production within each classification group is so marked that a classification rating alone is not of a great deal of value in estimating the producing ability of an individual cow. It seems obvious that a single animal cannot be selected from any one classification group with reasonable assurance that the animal selected will be better or worse in production than an individual animal selected from any other group.

In comparing the "Excellent" animals with records with those classified as "Very Good" having records and doing this at random for the entire group, it was found that in fifty-eight per cent of the times, the "Excellent" cows had higher records than the "Very Good" cows. On the same basis, the chances were fifty-six out of one hundred that a "Very Good" cow would have a higher record than a "Good Plus" cow. The chances were fifty-three out of one hundred that a "Good Plus" cow would excel a "Good" cow and the possibility of a "Good" cow exceeding a "Fair" cow in production was fifty-two times out of one hundred chances. The odds on an "Excellent" cow having a higher record than a cow classified as "Good," were found to be about sixty-three to thirty-seven or sixty-three times out of one hundred comparisons, an "Excellent" cow will exceed a "Good" cow in production.

The possibility of any ten animals picked at random in any classification group, excelling any ten others selected at random from a different classifica-

tion group was of interest and such selections were made five times. In making these selections, ten animals were picked at random from each classification group and compared with ten animals picked at random from the other classification groups. The only provision was that no two animals in any one group be by the same sire. The results are shown in Table 6.

TABLE 6

Chart showing average yield of 10 records selected at random from each classification division

Classification	Group 1 (Average of 10 records)	Group 2 (Average of 10 records)	Group 3 (Average of 10 records)	Group 4 (Average of 10 records)	Goup 5 (Average of 10 records)
Excellent	645	663	612	595	718
Very Good	583	617	686	587	688
Good Plus	591	528	509	567	579
Good	557	539	519	585	532
Fair	555	543	603	582	630

It also seemed pertinent to ascertain if the production records of the cows classified were affected by the age at classification. In other words, would animals rated "Excellent" as mature cows be apt to have any higher records than animals rated "Excellent" as immature cows or as old cows past their prime of life. All of the animals classified with production records were divided into three groups. The first group consisted of those cows classified at under five years of age. The second group was composed of animals classified at from five to nine years of age, inclusive, and the third group was composed of cows classified at ten years of age or older. The average production for each age group and for each classification was determined and the results are given in Table 7.

The results shown in this table indicate that age at classification is not a factor affecting the production records of the animals classified. This result was expected for in making the official classifications, the judges are not influenced to any extent by the fact that an old cow may have previously completed an exceptionally high record. The sole guide for classification work is the scale of points of the American Jersey Cattle Club.

It was next determined that a total of fifty bulls have been classified, each having ten or more officially classified daughters. The average score of each bull's daughters was then computed by assigning an arbitrary score of 95.00 for each daughter rated "Excellent," 87.50 for each daughter classified "Very Good," 82.50 for each daughter classified "Good Plus," 77.50 for each daughter rated "Good," 72.50 for each daughter classified "Fair" and a score of 60.00 for each daughter rated as "Poor," in conformation. There were ten bulls rated "Excellent" each with ten or more classified daughters and the average score of all the classified daughters was 85.44 per cent.

TABLE 7

Production records of cows classified at various ages

	Excellent		Very good		Good plus		Good		Fair	
	No.	Av. yield	No.	Av. yield	No.	Av. yield	No.	Av. yield	No.	Av. yield
Cows classified at under 5 years of age	73	658.03	261	634.91	509	603.71	352	585.96	35	570.60
Cows classified at from 5 to 9 years of age	103	653.87	287	616.10	396	599.14	210	590.56	22	625.18
Cows classified at 10 years of age or over	52	632.02	101	615.41	86	614.84	35	580.29	6	570.17
Totals	228	650.32	649	623.57	991	602.93	597	587.26	63	589.62

There were eighteen bulls rated "Very Good," each with ten or more classified daughters, the daughters having an average score of 83.78 per cent. There were twenty bulls rated "Good Plus" in this category and the average score of their daughters was 81.57 per cent. Finally, there were two bulls classified as "Good," each with ten or more classified daughters and the average score of the daughters was 80.72 per cent.

These results may or may not indicate anything. The numbers are entirely too few to be reliable but from the limited number, it does appear as though there might be some relationship between the type or conformation of a bull and the type and conformation of his daughters. However, it must be remembered that in all probability, the better type bulls were bred to better type cows, while the bulls rated in the lower classification groups were probably bred to cows not so good in conformation.

There were also a number of classified bulls that had qualified as "Tested Sires" with ten or more tested daughters. Likewise, a number of the cows classified have qualified as "Tested Dams," each with three or more tested progeny. These bulls and cows were divided into groups, depending upon their classification ratings and the average yields of their tested progeny obtained. The results of this phase of the analysis are given in Table 8.

TABLE 8

Classified bulls and cows qualifying as tested sires and as tested dams

Classification groups	Bulls		Cows	
	Number	Av. yield of tested progeny	Number	Av. yield of tested progeny
Excellent	13	635	9	619
Very Good	17	607	21	607
Good Plus	17	619	38	632
Good	6	706	14	598
Fair	—	—	1	637

In this table also, the numbers are unfortunately too limited to be dependable but it is significant to note that both with the cows and bulls, there does not seem to be any distinct relationship between the classification ratings of the animals and the production of their progeny. There were several bulls and cows in the "Excellent" group with high producing and high classifying progeny. Such animals are the ideals which breeders are seeking and it is on such cows and bulls that breeders must depend for future breed improvement. Obviously, as classification work increases from year to year, further data will eventually be available but until that time, few definite conclusions can be drawn concerning the relationship between the type of an animal and either the type or the production of the progeny.

SUMMARY

In reviewing and summarizing the entire problem, it is very unfortunate that the numbers are so limited and also that an equal percentage of the cows classified in each group were not tested. If every animal classified had an official production record, the conclusions would then certainly be important in adding to our knowledge of breeding better dairy cattle. The results however do indicate that there is definitely some relationship between the conformation of a cow and her producing ability and that both good conformation and high production can be combined in the same animal. They are certainly not inimical to each other. On the other hand, it seems a fallacy to suppose that by breeding solely for production, we may secure ideal breed type or that by breeding solely with type in mind, we can secure the ideals in production. Breeders must continue to select and breed with both ideals in mind and only by following such a practice can our dairy breeds be definitely improved and made more uniform in conformation and producing ability.

SWEETENED CONDENSED WHEY: ITS MANUFACTURE AND PROPERTIES

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Whey, as a by-product in cheese manufacture, is produced in relatively small quantities in widely scattered factories. A soluble, edible, dry whey can be made in large cheese producing areas where sufficient material is available to operate a spray drying unit. But since whey contains approximately 93 per cent water and is an excellent medium for bacterial growth, it cannot be profitably shipped long distances for processing. The small cheese factory which is not located near a suitable drying plant must either return its whey to the farmer for hog feed or discard it.

Sweetened condensed whey was developed in the hope that it might help to fill the need for a cheap and simple method for preserving whey for human food. The new product is essentially sweetened condensed milk with the casein and milk fat removed.

Sweetened condensed whey has many possible uses in food preparations, but since work on this phase of the subject is still unfinished details will appear in a later paper. The mixture may be added to any food where both whey solids and sugar are desired. It has been used experimentally in fruit jams and whips, certain bakery products, and as an ingredient for several types of candy. Sweetened condensed whey has excellent whipping properties but without flavoring it is not pleasing to the taste. However, with the addition of suitable flavoring material, the product should be useful at soda fountains as a topping for hot chocolate, sundaes, cakes, and similar foods.

EXPERIMENTAL

Work was conducted to determine the feasibility of preserving whey solids with sugar; the optimum quantity of sugar to use; the most satisfactory total solids value for the condensed product; the effect of storage upon viscosity; the value of including butterfat or coagulated whey protein in the concentrated mixture; and finally to investigate any special properties which might enhance the use of the material in food products.

Swiss and cheddar cheese whey and rennet casein whey were available for the work. Cane sugar was used as the preserving agent except where glucose or invert sugar are specifically mentioned. Unless otherwise stated, the whey which was used in all experiments was centrifugally separated to remove the butterfat left in the cheese making process.

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The process of manufacture employed for making sweetened condensed whey was somewhat similar to that used in producing sweetened condensed milk. The whey was pasteurized at 62° C. for 30 minutes, the required quantity of sugar added, and the mixture evaporated in an 18-inch tinned copper pan under 26 to 28 inches vacuum. The condensed product was cooled to 35° C. and stirred for 3 or more hours at room temperature. Very small lactose crystals were essential in the preparation of a smooth product.

Samples of sweetened condensed whey were stored in airtight containers for observation of keeping quality and change in viscosity. Unless otherwise noted, storage was at room temperature, which varied between 25° C. and 30° C.

Viscosity determinations were made with a McMichael viscosimeter at 25° C. Readings were recorded as soon as they remained practically constant. This point was generally reached after the viscosimeter cup had revolved for 5 minutes. Sweetened condensed whey, like many dairy products, developed a structure during storage which partly broke down with stirring. The products were stirred uniformly to adjust the temperature and to secure a representative sample. Some breakdown of structure was inevitable. The figures represent relative rather than true viscosity values but were suitable for comparative purposes. No attempt was made to differentiate plastic from viscous flow.

Apparent viscosity values were calculated in poises from the degrees McMichael on the instrument dial. Wires ranging from No. 18 to No. 30 were used with either the small or large plunger, depending upon the viscosity of the material under investigation. The wires and plungers were calibrated in accordance with instructions furnished with the instrument.

Overrun was determined by whipping sweetened condensed whey with an electrically operated household mixer, using high speed running at 1,000 r.p.m. without a load. Percentage overrun was calculated as 100 times the difference in weight of the same volume before and after whipping divided by the weight after whipping.

RESULTS

Attention was first focused upon the quantity of sugar sweetened condensed whey should contain. Preliminary experiments showed that in the case of concentrated whey with its high salt content, a 58 to 60 per cent sugar/sugar + water ratio was sufficient to retard bacterial growth. The ratio was calculated as follows: Per cent sucrose in sucrose + water = (% sucrose × 100) ÷ (% sucrose + % water). The quantity of sugar necessary to give a product of good keeping quality was low enough to allow considerable latitude in the total solids range of the condensed material. The practical limits for sweetened condensed whey were found to be between 70 per cent and 80 per cent total solids with the optimum at 76 per cent.

The proportion of whey solids to sugar has been expressed as the per cent whey solids ÷ per cent sugar or the W/S ratio. From the W/S ratio and the total solids (W + S) of a sample the percentages of whey solids, sugar, and sugar in water may be calculated. If W + S = 79.2 and W/S = 1.34 (Table 1), then W = 79.2 − S and $\frac{79.2-S}{S} = 1.34$ and S = 33.8%.

Data given in Table 1 show the effect of increasing the proportion of whey solids to sugar upon the viscosity of sweetened condensed whey. Each

TABLE 1

Effect of variations in the whey solids/sugar ratio upon the viscosity of sweetened condensed whey held at room temperature

W/S ratio	Total solids	Viscosity after 2 months
	Per cent	*Poises*
0.80	80.3	59.0
1.00	78.8	102.1
1.01	79.6	698.7
1.18	79.9	834.3
1.34	79.2	1,677.0

set of figures represents a different batch. The total solids of each run approximates 80 per cent, which is the upper practical limit to which the product may be concentrated. The viscosity figures therefore represent maximum viscosities for each W/S ratio after two months storage. For economical preservation a large W/S ratio was advantageous, but after the viscosity of the mixture exceeded about 800 poises the product became too heavy for general use. The values for the sugar in water concentration of the samples shown in Table 1 ranged from 72.6 per cent for the low whey batch to 61.9 per cent for the product with a W/S ratio of 1.34. If the mixtures had been condensed to 76 per cent instead of 80 per cent total solids, it would have been necessary to increase the quantity of sugar to obtain the same sugar/sugar + water concentration.

From the foregoing considerations it became evident that the simplest and most practical concentration of ingredients for sweetened condensed whey was approximately: Sucrose 38 per cent, whey solids 38 per cent, and water 24 per cent. Such a mixture had a sugar/sugar + water ratio of about 61 per cent. The best manufacturing procedure for this product was as follows:

The total solids content of the fresh whey was determined according to Sanders' formula (1), 0.24 × L + 1.2 × per cent fat, where L = the lactometer reading at 25° C. (Quevenne or Sp. Gr. scale). If the lactometer reading of separated whey was 29.17 then 29.17 × .24 + (1.2 × 0) = 7.0% whey solids. Then to each 100 pounds of fresh separated and pasteurized whey of 7.0 per cent solids was added 7 pounds of cane sugar. The mixture was con-

densed under vacuum to 76 per cent solids. At this point the specific gravity was 1.360 at 50° C. or 1.365 at 40° C. The mixture was cooled to 35° C. and stirred at room temperature for at least three hours. It was then held in sealed containers to prevent mold growth.

After the establishment of the optimum W/S ratio at 1.0 this factor was held constant in most of the subsequent work.

Data plotted in Figure 1 show the rate of increase in the viscosity of fresh sweetened condensed whey as the percentage of total solids was in-

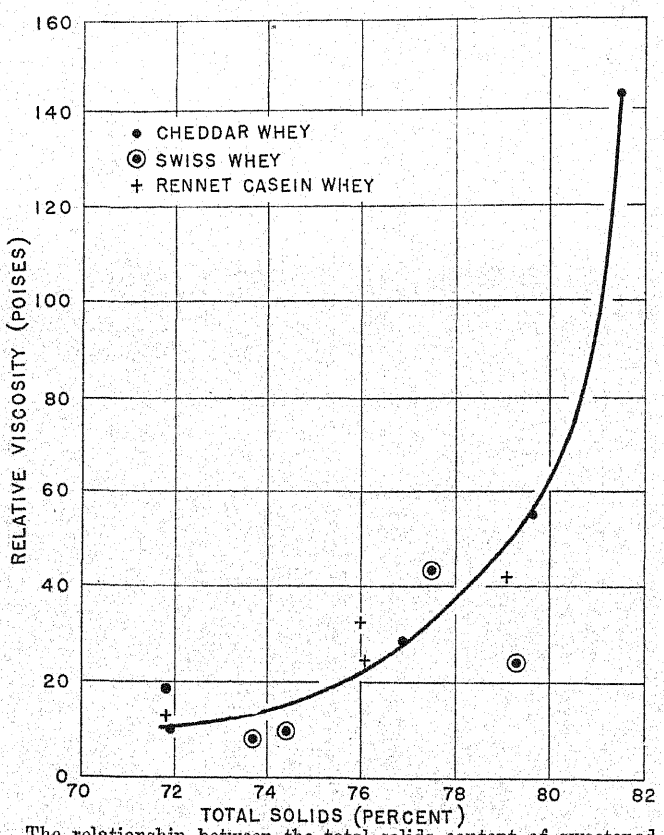

FIG. 1. The relationship between the total solids content of sweetened condensed whey and its viscosity.

creased by evaporation of water. Each point represents a result obtained on a separate batch made from different whey. The distance of some of the points from the curve emphasizes the difficulty which was experienced in obtaining accurate viscosity measurements, but it was felt that the data reflected the true rate of increase of relative viscosity with total solids.

The temperature of pasteurization of whey influenced the viscosity of the condensed product. Data for three temperatures are presented in Table 2.

densed to approximately this concentration. A few samples did not show a uniform viscosity increase during aging while some others (Table 2) did not increase as rapidly as the wheys of Table 3. Although a considerable variation in viscosity development during storage can be anticipated, especially when storage temperatures fluctuate, the normal viscosity increase which develops at cool room temperatures should not detract from the usefulness of the product.

Just as the viscosity of sweetened condensed milk was influenced by storage temperature, so also was this true for that of sweetened condensed whey. However, it was not intended that sweetened condensed whey should require cold storage temperatures, especially since the viscosity which it developed at ordinary temperatures was not detrimental. A thorough investigation of the influence of storage temperature was not made. However, the following figures were considered to represent the increase which would probably be encountered in the viscosity of sweetened condensed whey stored at different temperatures. The figures were obtained from measurements of a whey of 76.9 per cent total solids and a W/S ratio of 1.03. The whey solids included 2.4 per cent of coagulated whey protein added to increase the protein content of the mixture. The holding period was 97 days.

Storage temperature in °C.	Viscosity in poises
Check, not aged	34.0
2	44.9
10	52.0
20	61.4
Room	70.9
37	85.1

The addition of the coagulated whey protein raised the viscosity only slightly above that of most normal batches. While it was not deemed necessary to keep sweetened condensed whey in cold storage to retard an increase in viscosity, it was found desirable to store the product in a cool place to minimize the tendency toward thickening.

Sweet wheys containing butterfat or extra protein were investigated because of the possibility of their use in special food products where quantities of these ingredients were required. However, these additions increased the cost.

Experimental lots of sweetened condensed whey containing butterfat were made. Whey cream was added to give a final fat content of 6 to 14 per cent. This product when condensed to 75 to 80 per cent solids was quite viscous. It remained of good body and flavor during storage at room temperature for three or four weeks, but beyond this time a deterioration in butterfat flavor was noticeable. Some interesting data on the effect of replacing water by butterfat in concentrated sweetened whey are given in

Table 4. The viscosity of condensed whey was greatly increased by the addition of butterfat.

TABLE 4

Effect of replacing water by butterfat on the viscosity of sweetened condensed whey held at room temperature*

Total solids	Butterfat	Solids not fat	Viscosity after 2 months
Per cent	*Per cent*	*Per cent*	*Poises*
73.3	0.0	73.3	6.6
87.0	13.9	73.1	1816.7

* Whey solids/sugar ratio = 0.56.

The presence of small quantities of butterfat in sweetened condensed whey destroyed the whipping properties of the product. When the whey was not separated before condensing, as in the samples mentioned in Table 2, the small percentage of fat kept well during storage but it rendered the product unfit for use where whipping in air was desirable.

Several batches of concentrated whey were made to which extra whey protein was added. Heat coagulated protein was obtained by heating fresh whey and removing the coagulated protein which was at once redispersed by homogenization in a new lot of hot fresh whey. Sugar was added and the mixture condensed in the usual manner. The physical properties of this product were found to be little different from those of the normal condensed material. Data on the viscosity of a batch of this material held at different temperatures have been given above.

Both corn and invert sugar were substituted for part of the cane sugar in sweetened condensed whey according to the requirements of the food product in which the whey was to be used. However, the sucrose could not be entirely replaced by corn sugar because of the limited solubility of dextrose at room temperature. Invert sugar or honey, on the other hand, completely replaced cane sugar to give a sweeter whey, but for most uses only a partial substitution was necessary.

The general principles of the work of Ramsey, Tracy, and Ruehe (2) on the use of corn sugar in sweetened condensed milk were found to apply to sweetened condensed whey. The product became excessively brown during processing and storage when most of the sucrose was replaced by either corn or invert sugar. When dextrose or invert sugar was substituted for sucrose up to 50 per cent a satisfactory sweetened condensed whey was obtained.

One of the most promising features of sweetened condensed whey was the ease with which it could be whipped. The foam-producing whey protein permitted the incorporation of air during whipping while the high viscosity of the product aided greatly in stabilizing the whip.

The increase in volume during the whipping of sweetened condensed

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The increase in volume during the whipping of sweetened condensed

whey of different solids content is shown in Table 5. A whey sample containing 79 per cent total solids was diluted with water to various concentrations and whipped until maximum overrun was attained as determined by the point where further whipping did not incorporate additional air. The

TABLE 5

Effect of total solids upon the whipping properties of sweetened condensed whey. Whey/solids sugar ratio = 1.0

Whipping time at 30° C.	Overrun produced by wheys of different total solids content					
	Total solids content—per cent					
	79	75	70	65	60	50
Min.	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
1	84	72	67	101	93	27
2	138	143	127	121	159	
3	179	194	188	191	214	35
4	182*	213*	229	240	293	
5	179	213	254	281	340	39
6			259*	300*	358	
7			259	300	368*	43
8					368	
9						46
11						54*
* Stability of whip at maximum overrun. Temperature 28°–30° C.						
	Min. 3600	*Min.* 910	*Min.* 205	*Min.* 130	*Min.* 70	*Min.* 0

stability of the whips also is given in Table 5. This was determined as the time when the first drainage appeared in the bottom of a 150 cc. glass filled with whipped material.

It was not possible to obtain a stable whip when the total solids were 50 per cent. This mixture was too low in viscosity to have even slight stability. The sample containing 79 per cent solids was the most viscous and showed the greatest stability. The highest overrun was produced by the 60 per cent solids sample which was thin enough to allow an easy incorporation of air and at the same time viscous enough to hold it, at least for a short period.

For practical considerations it may be said that aging does not significantly influence the whipping properties of sweetened condensed whey.

The data of Table 6 show that approximately the same maximum overrun was finally obtained during whipping regardless of the aging period with its accompanying increase in viscosity. These data seem to indicate again that the increase in viscosity with age was largely an increase in apparent viscosity, hence the difficulty experienced in securing accurate viscosity measurements. As the aging period progressed and the viscosity increased (Table 6), the overrun for the first two minutes of whipping showed a de-

TABLE 6

*Effect of aging upon the whipping properties of sweetened condensed whey**

Whipping time	Overrun after different aging periods			
	Fresh	28 days	51 days	73 days
Min.	*Per cent*	*Per cent*	*Per cent*	*Per cent*
1	113	101	105	98
2	202	191	174	172
3	235	229	229	238
4	248	249	232	259
5	238	225	230	242
Viscosity of aged samples before whipping				
Poises	*Poises*	*Poises*	*Poises*	
9.4	17.9	35.4	49.6	

* Aged at room temperature. Measurements at 25° C. Whey solids/sugar ratio = 1.0. Total solids = 74.4 per cent.

crease. Apparently about two minutes of vigorous whipping was required to beat out the temporary viscosity which had developed.

Investigation was made of the effect of heating to various temperatures upon the whipping properties of sweetened condensed whey. Five hundred gram samples of 76 per cent solids sweetened condensed whey were heated to 70° C., 80° C., 90° C., and 95° C. for 5 minutes. The water loss was replaced, the samples cooled to room temperature and held at 23° C. for 24 hours with occasional stirring to recrystallize the lactose. The wheys were then whipped to their maximum overruns in 4 minutes for the unheated check and in 3 minutes for the heated samples. The overruns obtained were: Check, 144 with 180, 153, 147, 171 per cent in the order of increasing temperatures of heating. The whipped check sample showed its first drainage in 3 days, the 95° C. sample not until 5 days, with the others falling between these times. The data indicate that heat coagulation of the soluble whey protein is not detrimental to the whipping properties of the sweetened condensed product. Evidently the whipping properties of this material are dependent upon its high viscosity and, at least partially, upon a non-heat coagulable foam-producing material identical perhaps with that described by Ansbacher, Flanigan and Supplee (3).

SUMMARY

1. Whey solids were simply and inexpensively preserved in a form directly utilizable in sweet foods by condensing a mixture of fresh whey and sugar.

2. The most satisfactory procedure was to add to separated, pasteurized whey a quantity of sugar equal to the weight of the whey solids. The mixture was condensed under vacuum to 76 per cent total solids, cooled to 35°

C. and stirred for at least 3 hours to produce small lactose crystals. It was sealed in airtight containers.

3. The effects of manufacturing processes, of concentration of ingredients, and of storage conditions upon the relative viscosity of sweetened condensed whey were determined.

4. Sweetened condensed whey kept well during storage at room temperature for at least 3 months. The changes during such a storage period were a slight darkening in color and a small increase in viscosity. Holding at cool temperatures minimized the changes which occurred during storage.

5. Sweetened condensed whey was easily whipped to an overrun of approximately 200 per cent in 4 minutes. The whip was stable for 15 hours. The relationship between total solids content, overrun, and stability of whip was investigated.

ACKNOWLEDGMENT

The authors wish to express their appreciation for the able technical assistance of Mr. C. F. Hufnagel of the Dairy Research Laboratory Staff in the various manufacturing steps involved in this problem, including operation of the vacuum pan.

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SOME EFFECTS OF A VITAMIN D DEFICIENCY ON MATURE DAIRY COWS

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The important role played by vitamin D in preventing disease and promoting the efficient utilization of calcium and phosphorus by calves and young cattle has been established by the numerous experiments on this problem which have been reported in the last few years. Whether or not a deficiency of vitamin D in the nutrition of mature dairy cows will result in the development of any or all of the deficiency symptoms exhibited by calves under similar conditions has remained as an unanswered question. The possibility of vitamin D improving the utilization of calcium and phosphorus by mature cows so that positive balances of these minerals might be maintained during periods of liberal milk production has been studied by workers at the Wisconsin Station (6, 7, 8, 9, 10, 11, 12, 13). In this series of experiments, green roughages, roughages dried with varying amounts of sunshine exposure, sunlight, ultra-violet light, cod liver oil, and irradiated yeast were studied for their influence on calcium and phosphorus metabolism. They were used either as a part of the ration or supplemental to normal rations carrying different amounts of calcium and phosphorus. Under these conditions the authors were unable to demonstrate any consistent significant influence of vitamin D in improving the utilization of these minerals. Meigs and coworkers (14) also concluded from their work that the addition of cod liver oil to the ration had no favorable influence on calcium assimilation.

The present investigation was designed to study the necessity of vitamin D in the adequate nutrition of mature dairy cows by first depriving them of this factor, watching for the development of any symptoms which might result from a vitamin D deficiency, and then attempting by the administration of vitamin D to relieve or improve such conditions as might develop.

EXPERIMENTAL METHODS

The essential features of this experiment included the keeping of mature dairy cows under conditions as free from food and environmental sources of vitamin D as possible and making such observations as might reveal the development of any abnormalities commonly associated with a deficiency of this factor.

Five mature, grade Holstein cows have been used so far in this experiment. Three heavy milking cows of this group have supplied most of the data reported in this paper. The cows were kept inside except for occasional exercise periods in a dry lot after dark. Weights were obtained on three

consecutive days once per month. The rations were designed to be adequate except for vitamin D. To accomplish this it was necessary to use molasses beet pulp as the source of roughage as most of the common roughages carry more or less vitamin D. Samples of the beet pulp used were tested biologically in our laboratory and were shown to be free of detectable amounts of vitamin D. A grain mixture of ground yellow corn, ground oats, and corn gluten meal was used to balance the ration. The grain mixture also included common salt and sufficient bone meal to supply what would normally be an adequate amount of calcium and phosphorus. The mineral allowance provided at least 20–25 grams of calcium and 10 grams of phosphorus for maintenance of the cow and in addition 1 gram of calcium and 0.75 gram of phosphorus for each pound of milk produced daily. Additional vitamin A was supplied by a special concentrate which was shown by biological assay to contain no significant amount of vitamin D. The mangers were partitioned off so that each cow could be fed individually and refused feed accounted for on the feed record. Shavings were used for bedding.

Three-day composite blood plasma samples were obtained regularly at monthly intervals for the determination of total calcium and inorganic phosphorus. Additional samples were taken at irregular intervals whenever the condition of the animal indicated that pertinent data might be secured. Calcium was determined by adaptations from the method of Clark and Collip (2) and phosphorus by the Fiske-Subbarow method (4).

Calcium and phosphorus balances were determined in ten-day trials at about monthly intervals and more frequently when made necessary by the condition of the animal. The balance trial rations were fed for several days previous to the start of collection periods. They were weighed out in daily portions and sampled for analysis in advance of the trial. The cows were placed in adjustable metabolism stalls on elevated platforms so that a large pan with removable shield could be placed at the rear to collect the excreta which were aliquotted at regular intervals and composited at the end of the trial. The feed stuffs and excreta were analyzed by methods essentially the same as those described by Morris, Nelson, and Palmer (15).

Butter fat samples for vitamin D assay were obtained by saving all the milk from the cows concerned for a sufficient period of time to give a two-quart jar of pure butter oil after it had been separated, churned, and either filtered or centrifuged to remove the curd. It was stored at about 0° F. until assayed for vitamin D using the standard line-test technique.

Calcium and phosphorus analyses were run on milk samples taken from the colostrum, from a one-day composite at the end of the third day, and from two-day aliquots taken at the fifteenth day, thirtieth day, and at subsequent thirty-day intervals throughout the lactation.

The physical condition of the cows was observed at regular intervals and notations made of any conditions which would be of value in interpreting the

results of the experiment. The customary breeding, health, and milk records were also obtained.

RESULTS

In a study of this type the conditions and responses pertaining to each individual animal necessarily show some variations. To make the presentation as intelligible as possible the full set of observations and data for each cow will be given separately in this section. The implications of the data as a whole, and generalizations deduced therefrom will be presented later in the discussion section.

Cow 3E.—The animal designated as 3E was placed on the vitamin D deficient ration on Dec. 15, 1935. She completed a lactation in March and freshened normally on April 12, 1936. As shown in Chart 1, the total calcium of the blood plasma had been in the normal range of 10–12 milligrams per 100 cc. and the inorganic phosphorus in its normal range of about 5 milligrams per 100 cc. previous to the approach of parturition. No abnormalities were in evidence until two days after giving birth to a robust, 108 pound male calf when the cow seemed to be paralyzed in her back and limbs. She was unable to get up further than onto her knees but could then drag herself around the boxstall to a limited extent. The blood calcium at this time had declined to 5.3 mgm. per 100 cc. of plasma and the inorganic phosphorus to 3.1 mgm. Five hundred cc. of cod liver oil were administered over a two-day period in an attempt to improve her condition. The cow was on her feet the following day and in a few days was eating her feed readily. The rapid increase in the blood calcium and phosphorus is indicated on Chart 1. Milk production increased until she was giving about 62 pounds daily. A recession in the level of blood calcium and phosphorus soon set in again, and about four months after freshening evidences of stiffness began to appear. There was some swelling of the joints and the knees began to spring forward. She walked with the stiffness exhibited by calves suffering from a vitamin D deficiency, and scarcely flexed the joints of her legs. Her backbone became so stiff that she could not bend it to lick herself, neither did she flex it in walking or turning around. She had great difficulty in lying down and getting up and when standing she frequently lifted each foot with a trembling motion evidently to ease the pain by removing the weight from it.

A ten-day balance trial was run, and a sample of butterfat was saved for vitamin D assay just before these conditions became so severe that remedial measures had to be taken. As shown in Table 1, the calcium balance was negative by 24.06 grams and the phosphorus only slightly positive to the extent of 6.97 grams for the ten-day trial. There was no detectable amount of vitamin D in the butterfat sample as was indicated by the fact that five rats from different litters completed the assay requirements satisfactorily,

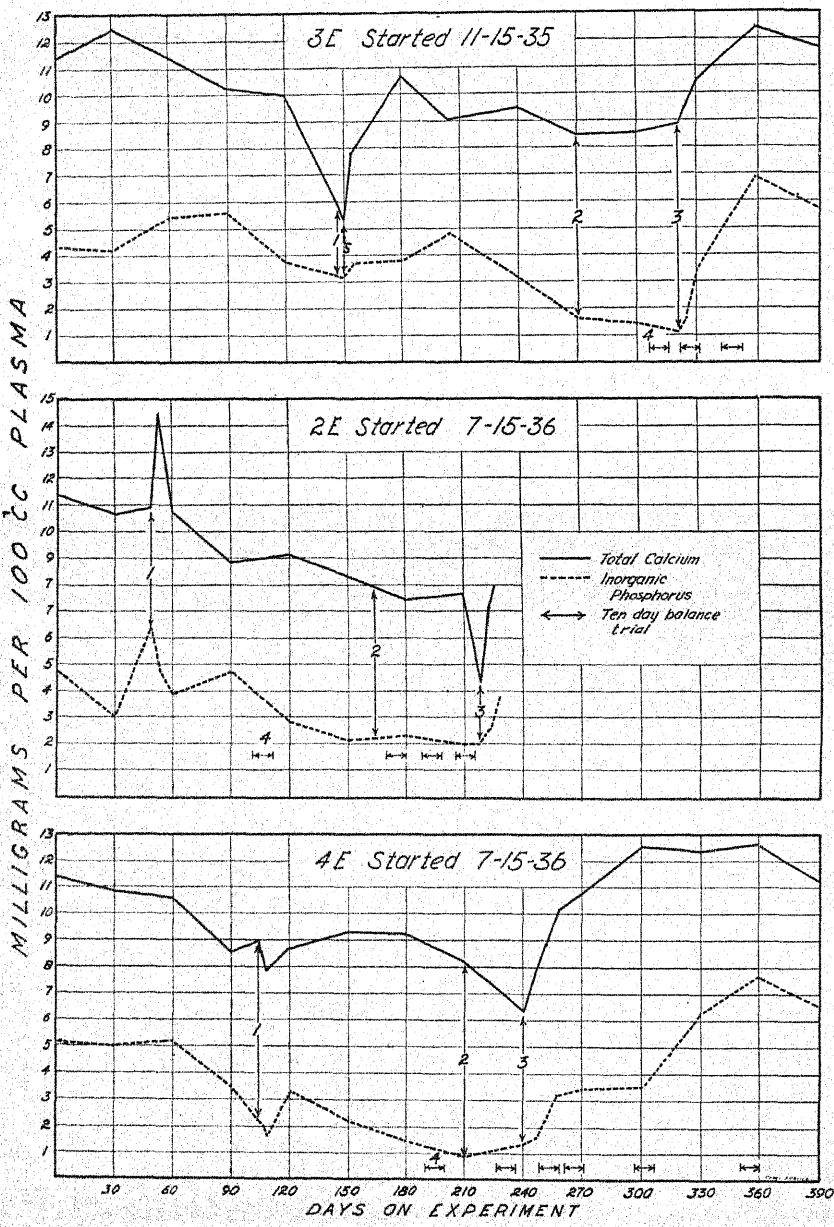

CHART 1. The total calcium and inorganic phosphorus in the blood plasma of mature dairy cows on a vitamin D deficient ration.

1—Time of parturition.
2—First appearance of stiffness.
3—Viosterol administration started.
4—Spacing of ten-day mineral balance trials. Results given in Table 1.
5—500 cc. cod liver oil given 3E in a two-day period.

TABLE 1

The results of ten-day calcium and phosphorus balance trials run on vitamin D deficient cows before and after the administration of vitamin D

Date trial started	Daily milk yield	Ten-day intake		Ten-day balance			
				Before feeding vitamin D		After feeding vitamin D	
		Calcium	Phosphorus	Calcium	Phosphorus	Calcium	Phosphorus
	lbs.	*gm.*	*gm.*	*gm.*	*gm.*	*gm.*	*gm.*
			3E 4–12–36 calving				
9–22–36	22.7	480.29	363.41	(−) 24.06	(+) 6.94		
10– 6–36	18.7	390.70	262.20			(+) 65.10	(+) 39.72
10–27–36	14.3	387.44	227.74			(+) 230.20	(+) 108.01
11–24–36	13.8	413.89	261.07			(+) 204.93	(+) 106.78
			2E 9–4–36 calving				
10–27–36	32.9	568.69	393.13	(−) 138.40	(−) 74.94		
1– 5–37	20.1	392.56	269.67	(−) 89.27	(−) 21.63		
1–20–37	16.0	295.01	169.25	(−) 81.06	(−) 54.94		
2– 9–37	13.0	323.91	182.95	(−) 55.96	(−) 24.57		
			4E 11–2–36 calving				
1–26–37	24.9	430.10	283.60	(−) 107.18	(−) 36.49		
3– 2–37	19.8	507.50	277.20	(−) 38.13	(+) 1.67		
3–23–37	18.9	561.31	296.78			(+) 131.78	(+) 48.49
4– 6–37	19.5	476.00	296.00			(+) 239.51	(+) 102.99
5–11–37	20.2	496.63	244.91			(+) 213.99	(+) 94.68
7– 6–37	22.5	576.19	343.57			(+) 185.38	(+) 101.16
Algebraic Totals				(−) 534.06	(−) 203.96	(+) 1270.89	(+) 601.83

but none of them showed any healing from the twelve grams of fat given each one during the test period.

Five and one-half months after parturition the blood calcium was down to 8.5 mgm. and the phosphorus to 1.1 mgm. per 100 cc., and her distress became so severe that 5 cc. of viosterol were given daily to supply vitamin D. Another mineral balance trial was started on the same day that viosterol therapy was initiated. A third balance trial was started ten days after the close of the second trial. The large calcium and phosphorus retentions which now prevailed as contrasted to the negative balance of calcium and slight positive balance of phosphorus under vitamin D deficient conditions are shown in Table 1. A fourth trial run two weeks later indicated the continued retention of large amounts of calcium and phosphorus. Three weeks after viosterol feeding was started the blood plasma calcium and inorganic phosphorus were back to the normal range again and the physical condition had improved to such an extent that only a slight stiffness could be discerned as she walked.

The calcium and phosphorus in the milk under the conditions of this lactation as compared with the amounts found in a previous normal lactation are shown graphically in Charts 2 and 3. The smoothness and similarity of

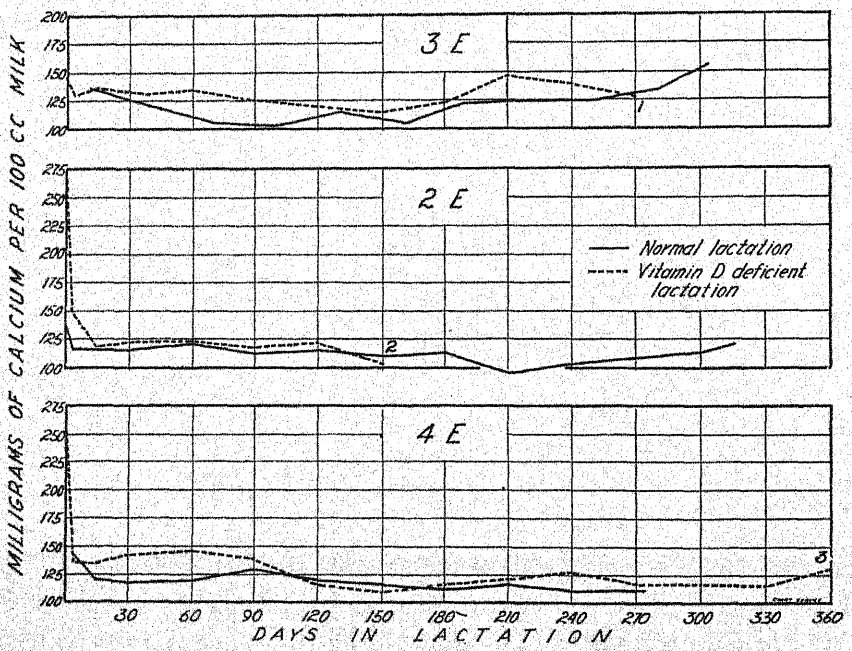

CHART 2. The concentration of calcium in the milk of three cows during a vitamin D deficient lactation as compared with a previous normal lactation.

1—Incomplete lactation—3E sold.
2—Cow 2E died.
3—Lactation still not completed. Delayed pregnancy due to failure of estrum during vitamin D deficiency allowed for extended lactation period.

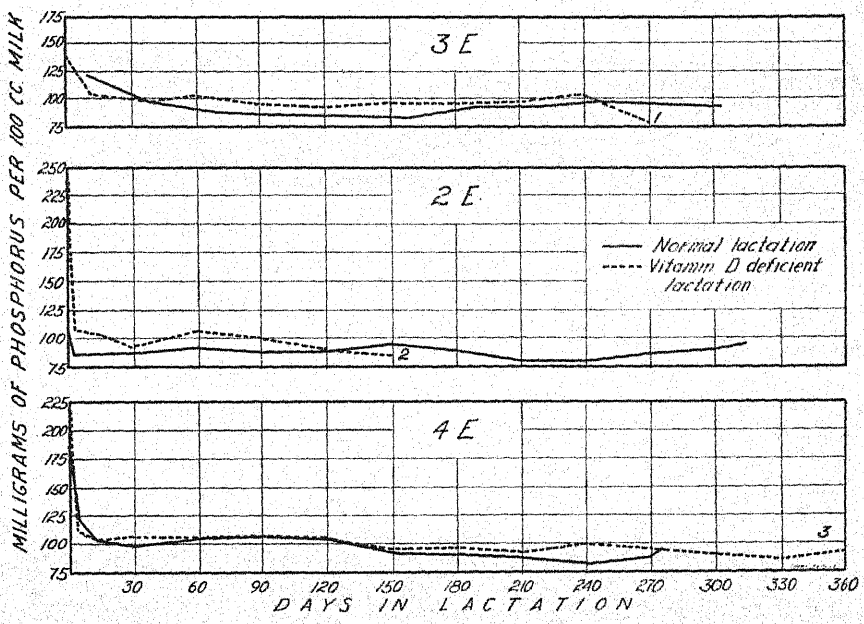

CHART 3. The concentration of phosphorus in the milk of three cows during a vitamin D deficient lactation as compared with a previous normal lactation.

1—Incomplete lactation—3E sold.
2—Cow 2E died.
3—Lactation still not completed. Delayed pregnancy due to failure of estrum during vitamin D deficiency allowed for extended lactation period.

the two curves in each case gives no indication that the level of calcium and phosphorus in the milk was affected significantly by the deficiency of vitamin D. A study of the percentage of calcium and phosphorus in the milk obtained in balance trials run before and after vitamin D therapy also substantiates this view. In the balance trials run under vitamin D deficient conditions the concentration of calcium in the milk was 0.1112 per cent and of phosphorus 0.0964 per cent, while in the two trials run immediately after feeding the vitamin D the calcium percentages were 0.1162 and 0.1091 respectively, and the phosphorus 0.0947 and 0.0876, respectively. Although the composition of the milk was not changed with regard to its calcium and phosphorus content, there was, however, a pronounced decline in the quantity produced, the drop from the high level of production in early lactation being much more rapid than for a comparable normal lactation.

Cow 3E was never observed to show estrum during the vitamin D deficient lactation although her breeding record previous to this time was very commendable. She was reported suspicious to the abortion test and was sold while still in milk nine months after calving.

Cow 2E.—This animal was transferred from a normal ration to the vitamin D deficient ration during the first week of July, 1936. After eight

weeks on this ration she gave birth to a strong, 101 pound male calf on Sept. 4. No abnormalities were in evidence although the blood plasma calcium and inorganic phosphorus had been declining previous to parturition and fluctuated conspicuously during the calving interval as is indicated in Chart 1. She was soon eating well and giving up to 42 pounds of milk daily. The blood plasma calcium and inorganic phosphorus continued to decline and on Oct. 27, about seven weeks after freshening the first mineral balance trial was run. There was no evidence of stiffness at this time. The large negative balances of both calcium and phosphorus are shown in Table 1. By the last of December, 15 weeks after freshening, stiffness was developing, the knees were swelling, and the back was elevated and held rigid as she moved about with a stiff, shuffling gait. Three more balance trials were run in rapid succession as shown in Table 1. During this time her physical condition became gradually worse so that by the end of the fourth trial she needed assistance to get to her feet although she was still in fair flesh. Her appetite was not keen and during the last two trials the mineral intake fell slightly below the desired intake to meet the calculated requirements for maintenance and milk production. Negative balances of calcium and phosphorus prevailed in all of these balance trials.

During the time that the vitamin D deficiency symptoms were pronounced a butterfat sample was saved for assay, but it was impossible to detect any vitamin D as indicated by the fact that the seven rats receiving 12 grams of this fat showed no signs of healing except for a mere trace on one animal. A photograph was also taken to show how her knees were buckled forward. This picture is shown in Figure 1. On February 23, about 23 weeks after freshening, and following the completion of the fourth balance trial, an attempt was made to secure a few more feet of moving pictures to supplement those previously taken to show the movements characteristic of this deficiency, but the animal was unable to get up even with the help of three or four men. She showed some tetany after slight exertions. A blood sample was taken in which the calcium was found to be only 4.35 mgm. and the inorganic phosphorus 2.00 mgm. per 100 cc. of plasma. Five cc. of viosterol were given in a drench and this was continued twice daily for the next five days. The rapid improvement in the blood plasma calcium and inorganic phosphorus is indicated in Chart 1. Although she was unable to get up, she continued to look bright and alert, and to eat some for three or four days. Gradually, however, her eyes dulled, her ears began to droop, and she became more and more listless until she died on March 1, six days after she was first unable to get up.

The Veterinary Department assisted with a post mortem examination in which it was found that both femur bones had been broken. Large hemorrhagic areas were present throughout the region of the hip and thigh muscles. Some fiber formation had taken place and the muscle tissues were decomposing, indicating that the bones had been broken for several days. This

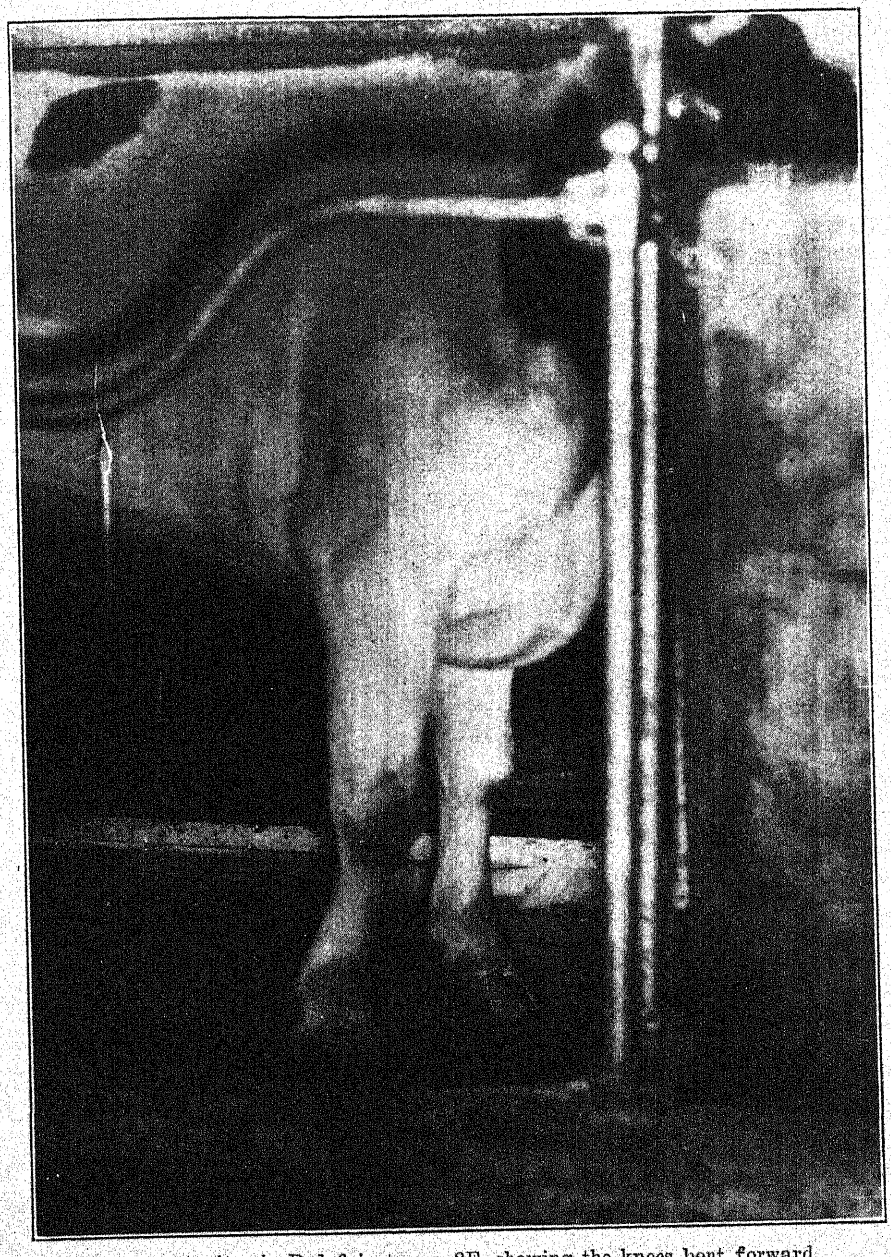

FIG. 1. A vitamin D deficient cow, 2E, showing the knees bent forward.

observation also harmonizes with observations made in the barn notes by the man attending the animal. The broken end of one femur had punctured the abdominal wall. It was quite evident that generalized septicemia had been the immediate cause of her death. The bones must have been uncommonly brittle as likely they were broken sometime when the cow was attempting to get up. She was never seen to struggle violently at any time. One can only conjecture as to whether or not the vitamin D deficiency played any part in making the bones fragile but it would seem quite possible that it may have contributed to this condition. A picture of these bones is shown in Figure 2.

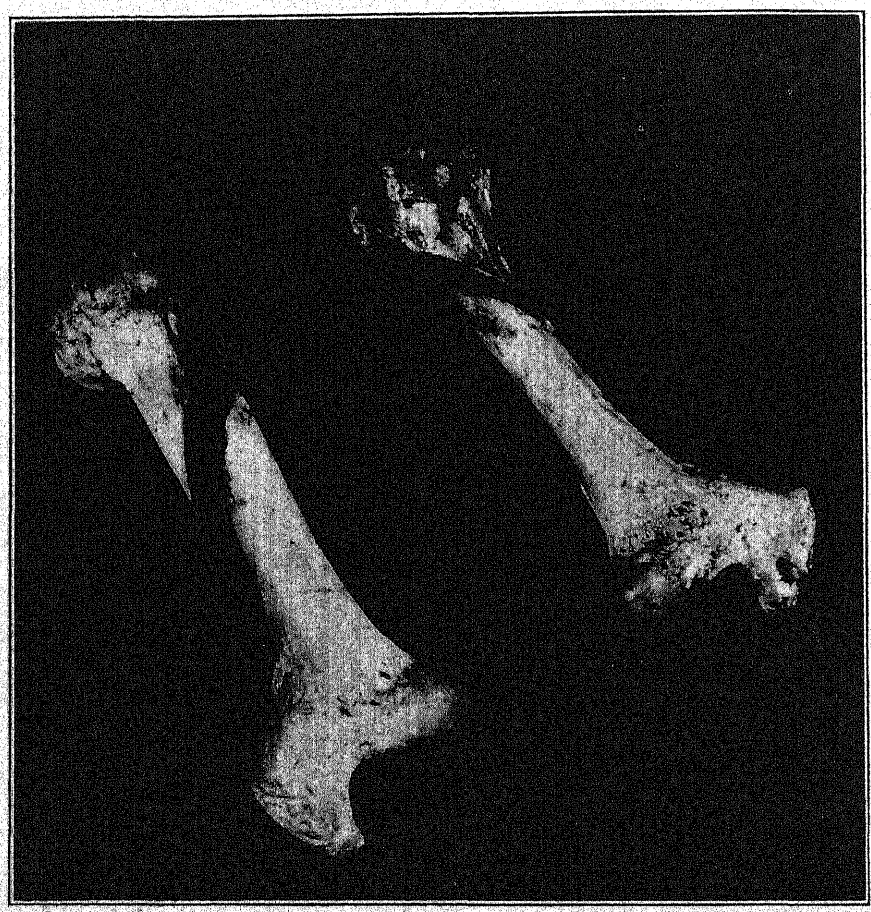

FIG. 2. Broken femur bones from a vitamin D deficient cow, 2E.

The articulating surfaces of the joints seemed to be smooth and normal except for an eroded area about $\frac{3}{4}$ inch in diameter on the proximal end of the right humerus. The ovaries seemed normal, but one of them contained a corpus

luteum which may account for the fact that this animal never showed estrum during this lactation although per previous breeding record was entirely regular.

The data shown in Charts 2 and 3 indicate that the amounts of calcium and phosphorus in the milk produced under the severe vitamin D deficiency conditions of this lactation were not essentially different from the amounts contained in the milk of a previous normal lactation. As it was not possible to run a balance trial after vitamin D administration, a comparison of the calcium and phosphorus concentration in the milk before and after such a change in the schedule is not possible in this case.

Cow 4E.—This animal was also started on the vitamin D deficient ration early in July of 1936. Chart 1 shows that there was a steady downward trend in the blood plasma calcium and inorganic phosphorus which was accentuated the last six weeks before parturition which occurred on November 4, 1936. The 90 pound heifer calf seemed well developed, bright, and alert, but its legs were badly crooked, giving it an outward appearance of a rachitic condition as may be seen in Figure 3. The calf could stand and move around

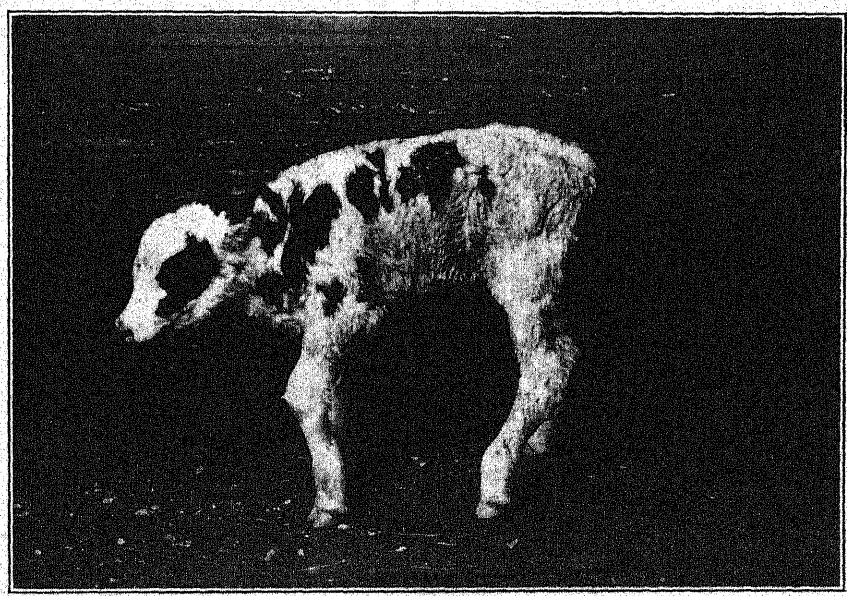

FIG. 3. Calf born to cow 4E after about four months on the vitamin D deficient ration.

but its body was only about two-thirds as far from the ground as it should have been. A blood sample from the calf showed the calcium to be 11.46 mgm. and the inorganic phosphorus 7.10 mgm. per 100 cc. of plasma. In four days the legs of the calf had straightened considerably. The cow did not show any external symptoms of deficiency disturbances.

There was a partial recovery in the blood plasma calcium and inorganic phosphorus following the low points and fluctuations associated with the calving period, but in about six weeks the downward trend again prevailed. The milk flow was maintained at about 40 pounds daily during the flush of the lactation. The first mineral balance trial was started on January 26, 1937, eleven weeks after calving. The blood calcium and phosphorus were subnormal but stiffness had not developed. The negative balances shown in Table 1 for this trial indicate large drafts on the calcium and phosphorus reserves of the cow.

By the last of February, 15 weeks after parturition, stiffness was quite noticeable, and the animal was in a thin condition from being off-feed. The desired level of mineral intake was maintained, however, by increasing the allowance of bone meal supplement. By the time a second balance trial was completed the animal was very stiff and could scarcely get up and down, or move around. No vitamin D could be demonstrated in a sample of butterfat saved for assay at this time. The blood plasma calcium was down to 6.46 mgm. and the inorganic phosphorus to 1.34 mgm. per 100 cc. in the three-day sample taken just before viosterol feeding had to be started on March 16, about 18 weeks after parturition. Five cc. of viosterol were given daily. In four days she was eating better, and in seven days when the next balance trial was started her appetite was still better, her eyes brighter, and her ability to move about much improved although she was still noticeably stiff. According to the results of this trial as shown in Table 1, the negative balances had changed to strongly positive balances. In the fourth trial which followed immediately, the retention of calcium and phosphorus increased by another large increment. In the fifth and sixth trials coming at later intervals the large mineral retentions were well sustained. In all six of these trials the milk production remained quite constant and the mineral intake was fairly uniform at adequate normal levels. Five weeks after starting viosterol feeding the stiffness seemed to have disappeared and her appetite had improved so that she was fleshing up from the excess nutrients consumed. About the middle of June cod liver oil was substituted for the vitamin A concentrate and viosterol to supply vitamins A and D. On July 16, 1937, she showed estrum for the first time since calving on November 4, 1936. She had now recovered and was seemingly in a fair state of health.

The calcium and phosphorus content of the milk during this lactation is compared with similar data for a previous normal lactation in Charts 2 and 3. Again, the curves are quite remarkable for their similarity. Furthermore, the analysis of the milk from balance trials run before and after viosterol feeding show no consistent differences to indicate a decrease in the calcium and phosphorus content of milk produced under conditions of severe vitamin D deficiency. In the two trials before feeding vitamin D the calcium in the milk was 0.1266 per cent and 0.1126 per cent and the phosphorus 0.0995 per

cent and 0.0958 per cent respectively, while in the two trials run immediately after vitamin D administration the calcium was 0.1088 per cent and 0.1123 per cent and the phosphorus 0.0984 per cent and 0.0954 per cent respectively.

Cow 1E.—A few observations made on this animal will be presented chiefly as they concern the effects of a vitamin D deficiency on the developing fetus. This cow was on the vitamin D deficient ration and was also dry at the time she became pregnant. She was continued under these conditions throughout the gestation period. The blood plasma calcium and inorganic phosphorus remained normal until about six weeks or two months before parturition when a downward trend developed. A low of 8.50 mgm. of calcium and 3.08 mgm. of inorganic phosphorus per 100 cc. of plasma was reached. There were fluctuations at calving time followed by a temporary recovery, then a decline as the lactation proceeded.

Some idea of the condition of the calf may be obtained from the picture shown in Figure 4. The legs were really less useful than the picture would indicate as they would bend and twist into most any shape if the calf tried to move about. The calcium in the blood plasma of the calf was 11.44 mgm. and the inorganic phosphorus 5.81 mgm. per 100 cc. The calf seemed to im-

FIG. 4. Calf from cow 1E. This cow was dry and on the vitamin D deficient ration throughout the entire gestation period.

prove slightly for 3 or 4 days then appeared to grow weaker again. It developed a light case of scours and died on the seventh day. It was fed only the milk from its vitamin D deficient mother. There was a feeling that the calf would have stood a good chance to live had it received some cod liver oil or other source of vitamin D, and possibly some vitamin A. The costo-chondral junctions of the ribs seemed to be enlarged so a histological study was made on the seventh rib by Dr. J. B. Taylor of the Veterinary Department. The structure was found to be essentially normal with regular columns of cartilage cells and a smooth line at the junction between the cartilage and calcified area. The ribs seemed light in weight and had only a very thin shell of mineral deposit. A little pressure caused the left sixth rib to crease and bend as a hollow straw. Analysis showed that on the green weight basis this bone contained 66.06 per cent moisture, 14.28 per cent ash, and 0.34 per cent fat (this determination may be a little low), leaving 19.32 per cent for other organic materials. The ash contained 38.24 per cent of calcium and 19.75 per cent of phosphorus.

DISCUSSION

In this section the data and observations just presented for individual animals will be analyzed for the broader implications and generalizations which may be drawn to suggest expected or possible effects of a vitamin D deficiency on mature dairy cows.

Total Calcium and Inorganic Phosphorus of the Blood Plasma

By referring to Chart 1 it may be noted that a gradual decline in the total calcium and the inorganic phosphorus content of the blood plasma set in soon after the cows were placed under vitamin D deficient conditions. Six weeks or so before calving the rate of decline was accelerated presumably because of increased demands on the mother made by the rapidly developing fetus. At calving time there were fluctuations up and down but usually all at subnormal levels. Following the stress of the parturition period there may be a partial recovery to normal concentrations but the requirements for a liberal milk flow initiated a downward trend again in two or three months. In about six months the level of calcium had reached a low of from 5–7 mgm. per 100 cc. of plasma in some cases, and the inorganic phosphorus had declined to 1–2 mgm. Upon the administration of viosterol to supply vitamin D recovery was rapid so that in about two or three weeks the concentrations were well back toward, or within, the normal range.

These observations were made on cows due to freshen within a few months of the time the experiment was started, and they were also liberal milk producers. Whether or not non-pregnant, dry cows and poor producing animals will respond similarly are unanswerable questions which are under investigation at the present time.

The Physical Condition of the Animal

With the exception of the peculiar paralysis of 3E at the time of parturition, these three heavy-milking cows all began to develop stiffness under vitamin D deficiency conditions about three or four months after the beginning of the lactation. It usually developed shortly after the decline in blood plasma calcium and phosphorus had been definitely established. From a slight stiffness the condition grew gradually more severe. The knees bent forward, the ankles straightened throwing the weight forward onto the toes, the joints showed some swelling, the back became slightly arched and quite rigid so that it was not flexed in walking, turning, or in other body movements. The gait was stiff, slow, and shuffling, when the animal was forced to move. The appetite usually failed some, and in two or three months the condition was often so severe that assistance was necessary in getting the animal to its feet. After viosterol administration to supply vitamin D some improvement in the appetite and ease of body movements could usually be noted in about ten days. Gradual improvement continued so that within one or two months the animal was apparently normal again as far as could be seen from external observations. Whether these conditions would develop with cows milking less liberally or with dry cows are questions under investigation at the present time.

The Calcium and Phosphorus Balances

The results of ten-day mineral balance trials distributed at advantageous points over the period of observation on these cows are summarized in Table 1. The trials run while the vitamin D deficiency was developing show negative balances for calcium in all cases and for phosphorus in all but two cases for which approximate equilibrium is indicated. When the mineral feeding was continued at a level adequate for maintenance and the amount of milk produced, these negative balances were all changed to strong positive balances upon the administration of viosterol to supply vitamin D. The data for 4E are especially pertinent for in this case the milk production remained practically constant for six different trials and the mineral intake quite uniform and never fell to questionable levels at any time through loss of appetite or other causes. The two trials run under vitamin D deficient conditions show significant losses of minerals from the body. Immediately upon administration of vitamin D these losses were converted into large retentions amounting to nearly one-half pound of calcium and one-fourth pound of phosphorus in a ten-day period. It is recognized that heavy-milking cows in the flush of the lactation often show negative calcium and phosphorus balances for a short time but positive balances have usually been reestablished before the milk production has declined to the levels indicated in these trials. That vitamin D plays an important role in the ability of heavy-milking cows to utilize calcium and phosphorus is indicated by the unusual losses of these min-

erals under vitamin D deficient conditions and the abrupt change to large retentions upon the administration of viosterol. It may be noted from the total figures at the bottom of Table 1, that the losses from the body during vitamin D deficiency and the subsequent gains following viosterol administration were both in approximately a 2 to 1 ratio and suggest a depletion followed by a subsequent restoration of the mineral reserves of the skeleton.

On first thought it might appear that these results are at variance with those previously referred to from the Wisconsin Station but the explanation undoubtedly lies in the two different approaches used. In the Wisconsin experiment vitamin D supplements were added to normal rations which undoubtedly carried enough of this factor to meet normal requirements so that no measurable effects on the calcium and phosphorus balances or condition of the animals were produced by adding still larger quantities of vitamin D. In the present work, the animals were first deprived of vitamin D whereupon deficiency symptoms developed thus providing favorable conditions for fundamental studies on the relation of vitamin D to the utilization of calcium and phosphorus as shown by balance trials, blood chemistry, and other conditions.

It is interesting to note that the effects of a vitamin D deficiency on the blood chemistry, physical condition, and calcium and phosphorus balances of mature heavy-milking cows as just related are very similar to those exhibited by young growing calves as reported by Bechdel, Landsburg, and Hill (1), Rupel, Bohstedt, and Hart (16), Duncan and Huffman (3), Gullickson, Palmer, and Boyd (5), and Wallis, Palmer, and Gullickson (18).

Calcium and Phosphorus in the Milk

The data obtained from analyzing two-day composite samples of milk from each cow at monthly intervals for calcium and phosphorus are shown graphically in Charts 2 and 3. In comparing them with results obtained in a previous normal lactation the similarity of the curves is the most striking feature. There is even a slight tendency for both the calcium and phosphorus concentration to be higher in the vitamin D deficient lactation. These curves are remarkably smooth, follow the normal curves closely, and show no tendencies to decline under these extreme conditions of vitamin D deficiency nor to rise upon the administration of vitamin D. There was, however, a more rapid fall in the amount of milk produced as the vitamin D deficiency became pronounced than was shown in normal lactations. It should be noted that none of the lactations of the vitamin D deficient period were entirely completed so the last part of these curves is not necessarily characteristic of completed lactation curves.

The data for the percentage of calcium and phosphorus in the milk from balance trials run before and after vitamin D therapy also support the same

conclusion; namely, that the vitamin D deficiency had no measurable influence on the concentration of calcium and phosphorus in the milk.

Vitamin D in Butterfat

The data obtained in the assays indicate that in none of these samples of fat taken from the cows while suffering severely from a deficiency of vitamin D was it possible to demonstrate the presence of measurable amounts of vitamin D. Twelve grams of fat were mixed with the rachitogenic diet and fed during the first eight days of the test period. This is about all the rats would consume regularly during the test period so larger amounts could not be used. Unsuccessful attempts to concentrate any possible vitamin D in the butterfat so a more searching test could be made have been discussed by the author (17) on a previous occasion.

Effects on the Developing Fetus

Cow 2E dropped a fine normal-appearing calf after two months of the dry period under the vitamin D deficient conditions. The calf from 3E born four months after starting the experiment, showed slightly bent knees and cocked-ankles, but straightened up in a week or so. The calf from 4E, born after four months on the deficient diet, is shown in Figure 3. The legs are extremely crooked, but the blood plasma calcium and inorganic phosphorus were normal. The legs gradually straightened over a period of two or three weeks. The calf from 1E is shown in Figure 4. This cow was dry and on the vitamin D deficient regime throughout the gestation period. The blood picture was essentially normal, and the histological studies made on the costochondral junction of the seventh rib after its death on the seventh day showed no evidences of rachitic malformations. The high moisture content and the low fat and ash contents indicated by the analyses of the sixth rib are interesting but at the present time we do not have figures from comparable normal calves with which to compare them. The calcium and phosphorus found in the ash approximate the figures generally reported for bone ash. The evidence indicates that calves born to cows maintained for a considerable length of time under vitamin D deficient conditions may have a decided rachitic appearance and possibly a lowered mineral content of the bones. Blood chemistry and histological studies, however, have shown normal conditions to prevail in these respects.

Bones of the Animal

In connection with 2E the evidence has already been presented which may possibly indicate that the vitamin D deficiency has had some relation to the marked fragility of the bones encountered in this case.

Breeding Efficiency

The breeding records are available for these animals for at least two lactations previous to the experiment. The regularity shown by these records stands out in striking contrast to the fact that none of these cows showed estrum during the period of vitamin D deficiency. It is not clear, however, whether this condition should be attributed to the lack of vitamin D *per se*, to the decline in general health and vigor of the animals, or perhaps to some other factor entirely.

SUMMARY

Detailed observations on three liberal-milking cows and one dry, pregnant cow kept under vitamin D deficient conditions have been presented. Under these conditions the total calcium of the blood plasma declined to one-half normal values, and the inorganic phosphorus to one-fifth normal. The animals became stiff, the knees bent forward, the spine became rigid and in severe cases assistance was necessary before the cow could get up. Balance trials run while these conditions prevailed showed that significant drafts on the calcium and phosphorus reserves were being made. When vitamin D was administered the losses were immediately changed to unusually large retentions. The curves showing the calcium and phosphorus concentration in the milk are remarkably smooth and coincide closely with similar curves for previous normal lactations. Calves produced after the cows had been under the deficiency conditions for some time showed visible rachitic appearances but blood chemistry and histological studies revealed no abnormalties in these respects. Vitamin D could not be detected in butterfat samples saved from animals deficient in this factor. Whether or not the fragile bones encountered in one animal and the failure of all the animals to show estrum are directly connected with the lack of vitamin D cannot be established at the present time.

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ABSTRACTS OF LITERATURE

BACTERIOLOGY

225. Bactericidal Property of Milk. RALPH B. LITTLE, Rockefeller Institute, Princeton, N. J. 25th Ann. Report of Intern. Assoc. Milk Sanitarians, p. 105, 1936.

All milks studied had a substance present which inhibited the growth of non-hemolytic mastitis streptococci and known cultural strains of scarlet fever streptococci. This inhibitory effect was noticeable for several hours. The concentration of the inhibitory principle varies in the secretions of different animals and frequently in the quarters of the same animal.

It is assumed that the substance is produced in the udder of the animal and that its function is primarily a natural means of restraining the growth of bacteria in the udder.

Whether or not this substance is potent for many kinds of bacteria is not known. However, we must realize the opportunity available for the entrance of bacteria into the teat canal, yet, in the main, the flora of the udder is limited to relatively few species; and these species have probably become well adapted to the environment and to the influence of this inhibitory substance. L.HB.

BUTTER

226. Regulatory Problems Relating to the Manufacture of Butter. CHARLES S. TRIMBLE, U. S. Bureau of Dairy Industry, Washington, D. C. 25th Ann. Report of the Intern. Assoc. Milk Sanitarians, p. 311, 1936.

A discussion of some of the phases of butter manufacturing which require supervision by regulatory agencies. L.H.B.

227. The Cold Storage of Butter. F. BROCHOT, Le Lait *18*, 171, p. 23, Jan., 1938.

Refrigeration equipment in cold storage chambers for butter is discussed. The importance of maintaining a low humidity in the butter storage chamber is emphasized. In putting butter into storage for long periods, the work indicates that the butter be prepared from cream pasteurized at a high temperature and manufactured carefully and not permitting contact with copper. The butter storage chamber should be free from mold and should be washed with chlorine solution before storage of the butter. Light should be excluded from the butter storage chamber. Condensed water from cold surfaces in the cold storage chamber should be eliminated as far as possible. A.H.J.

228. The Diacetyl in the Butters of Normandy. CH. BRIOUX AND EDG. JOUIS. Agronomic Sta. of the Lower Seine. Le Lait *18*, 171, p. 11, Jan. 1938.

The diacetyl and acetyl methyl carbinol contents of a considerable number of butters were determined by the method of Pien. Determination of acetyl methyl carbinol was accomplished by introducing 100 grams of the butter into a 300 to 400 cc. flask, adding 20 cc. of iron perchloride and distilling slowly with steam until 50 cc. of distillate were obtained. Ten cc. of the distillate were then used in the colorimetric determination of the contained diacetyl according to the method of Pien. Fresh Norman butters contained normally a small quantity of diacetyl, usually from 0.05 to 0.5 milligrams of diacetyl per kilogram and in rare cases as much as 2.5 milligrams of diacetyl per kilogram of butter were found. Butters made in cooperative or industrial creameries contained considerably more diacetyl than butter made on the farm. The diacetyl normally contained in fresh butter disappeared rapidly on storage of the butter. Fifteen to 18 days after manufacture of the butter, the diacetyl content decreased to $\frac{1}{10}$ its original value. The acetyl methyl carbinol contents of butter are considerably higher than the diacetyl contents, usually between 10 and 30 milligrams per kilogram of butter, but some butters may contain as high as 69 milligrams per kilogram. The acetyl methyl carbinol did not appear able to give rise to an appreciable quantity of diacetyl. The diacetyl and acetyl methyl carbinol contents of fermented cream containing 95.2 milligrams of acetyl methyl carbinol per kilogram yielded butter and buttermilk containing 42.4 and 195.3 milligrams of acetyl methyl carbinol per kilogram respectively. The same cream containing 1.92 milligrams of diacetyl per kilogram yielded butter and buttermilk containing 1.50 and 3.10 milligrams of diacetly per kilogram respectively.

A.H.J.

Other abstracts of interest are numbers 246, 251, and 254.

CHEESE

229. Cheese Vats of Non-oxidizable (Stainless) Steel. JOSEF KRENN, School and Federal Exp. Sta. for the Dairy Industry, Wolfpassing, Austria. Le Lait *18*, 171, p. 1, Jan., 1938.

It was noted that when curd was prepared in non-oxidizable steel vats, the curd adhered to the walls of the vat and formed a spongy coagulum while when copper vats were used the curd drew away from the wall and formed a more desirable hard curd free from whey. It was not that this phenomenon was due to the probability that in the case of copper containers, minute traces of the copper walls dissolved allowing thereby the curd to draw from the walls. This explanation was found to be incorrect. It made no difference whether raw milk, pasteurized milk or skimmilk used in the vats, the curd in all cases adhered to the stainless steel or nickel chromium vat, while it drew away from the copper vat. Modifying the acidity of the milk, or the temperature or the

amount of rennet had no effect. The curd adhered to glass containers but not to glazed porcelain. The state or condition of the surface of the inoxidizable steel (degree of polishing) was without affect on the adherence of the curd to the surface. It appears to be a particular property of the inoxidizable steel surface that curd presents a particularly high attraction for it. In order to suppress this attraction, it is sufficient to grease carefully the inoxidizable steel vat with butyrin. The cheese curd then detaches itself as easily and as freely from this greased surface as from a copper vat. A.H.J.

CHEMISTRY

230. Some Observations on Chlorine and Metals. Fred M. Grant, Bureau of Dairy Industry, U. S. Dept. of Agr., Washington, D. C. 25th Ann. Report of Intern. Assoc. Milk Sanitarians, p. 9, Oct., 1936.

This paper presents the observations made on the corrosive action of a chloromin-T compound and of a calcium hypochlorite and sodium carbonate mixture on seven different metals, tin, black steel, Monel metal, allegheny metal, copper, aluminum and bronze. The solutions used were of a strength of 200 ppm. of available chlorine. Weighed metal strips were used all of such size that an equal surface was presented in each instance.

It was found that bronze and copper were affected most by the chloramin-T and least by the hypochlorite solution. Tin, Monel metal and allegheny metal were practically untouched by the chloramin-T, but Monel metal and tin were mildly effected by the hypochlorite solution. Aluminum, although strongly attacked by hypochlorite, was only mildly effected by chloramin-T. L.H.B.

CONCENTRATED AND DRY MILK; BY-PRODUCTS

231. The Progress of the American Industry with Compounds of Lactic Acid. G. Genin, Paris, France. Le Lait *18*, 171, p. 43, Jan., 1938.

Milk is freed of its fat and much of its protein. The remaining serum is the source of the sugar for fermentation. The appropriate organisms are added to this serum, and in 10 to 24 hours the lactose is converted into lactic acid. In the course of the fermentation, lime is added from time to time. During the fermentation the temperature is held at about 100° F. When the fermentation is complete, the liquid is neutralized with lime and heated to 180° F. to 220° F. On cooling a slime separates out. The liquid containing the calcium lactate is siphoned off and concentrated under vacuo. After cooling calcium lactate separates from the condensed liquid. Purification is effected by washing the crystals in a centrifuge. The crystals are then dissolved and the solution heated to 140–160° F., the solution also having its pH raised to 10–12 by the addition of calcium oxide. After standing 2–3 hours, the last impurities separate as a slime. The supernatant liquid is

drawn off and neutralized with lactic acid. A further purification may be made by the use of decolorizing carbon. The purified solution is finally cooled and the calcium lactate crystals obtained by centrifugation. A modification of this process is also described. Sodium lactate may also be prepared by treating a solution of calcium lactate with sodium sulphate. The precipitate of calcium sulphate is filtered off and the sodium lactate concentrated under vacuo to a syrupy consistency. Lactic acid can also be prepared from calcium lactate by adding sulphuric acid to a solution of calcium lactate. The lactic acid thus obtained has a slight brown color. This color can be removed by treatment with decolorizing carbons or by treatment with potassium ferrocyanide. A.H.J.

232. Concerning the Use of Casein in the Fabrication of Plastic Materials. G. GENIN, Paris, France. Le Lait *18*, 171, p. 45, Jan., 1938.

A review of the development of plastic materials from casein is given with special reference to the often overlooked work of Trillat. A.H.J.

Other abstracts of interest are numbers 251, 252, 253, 256, and 257.

DISEASES

233. The Present Status of Bang's Disease in Man. RICHARD KERN, Univ. of Penn., Philadelphia, Pa. 25th Ann. Report of Intern. Assoc. of Milk Sanitarians, p. 248, 1936.

This paper gives a very complete history of Bang's disease.

Up to 1935, 9,965 cases have been reported. However, it is apparent that not all cases are reported.

As a result of some of the work done by the government during the last few years, it was found that of 3,317,760 cows examined in this country, 381,657 were reactors, an incidence of 11.2 per cent. Nearly 50 per cent of all herds examined have some reactors.

The disease may be contracted by ingestion of infected raw milk or by contact. Pasteurization will take care of the milk infection, but the underlying problem is eradication of the disease in animals; this must be accomplished. L.H.B.

234. Milk-Borne Streptococci Infections. E. L. STEBBINS, H. S. INGRAHAM AND E. A. REED, Div. of Communicable Diseases, State Dept. of Health, Albany, N. Y. Am. J. Pub. Health *27*, 12, p. 1259, 1937.

An analysis was made of 1,529 cases of milk-borne streptococcus infections occurring in 7 epidemics in New York State during 1934–1936. In 6 epidemics, the source of contamination of the milk supply was a cow suffering from an acute mastitis caused by a hemolytic streptococcus of the type usually

associated with human infection (Lancefield Group A) and there was suggestive evidence of a human source of the bovine infection in each instance. The clinical and epidemiological observations are discussed. M.W.Y.

235. Undulant Fever in Milk, and Its Relation to Bang's Disease in Livestock. G. W. ANDERSON, Mass. Dept. of Public Health. Boston, Mass. J. of Milk Tech. *1*, 1, p. 26, Oct. 1937.

The existence of infection through the medium of raw milk must be recognized. The responsibility of the health officer is discussed.

L.H.B.

236. An Outbreak of Septic Sore Throat in Bergen County, (N. J.). W. H. MACDONALD, N. Y. State Dept. of Health. 25th Ann. Report of Intern. Assoc. of Milk Sanitarians, p. 180, 1936.

In a period of 27 years since 1909 the New Jersey State Dept. of Health investigated 58 disease outbreaks traceable to milk. Fifty-seven of them were traced to raw milk, the other one was traced to pasteurized milk wherein the bottles were hand-capped (20 years ago before machine capping was required) by a person with a mild case of typhoid fever.

Not until 1934 was septic sore throat listed among the milkborne epidemics. Since then three such epidemics have occurred with 325 or more cases and 9 deaths. The last outbreak occurred in April and May, 1936 when 175 cases or more had occurred and there were seven deaths. L.H.B.

237. The Present Status of Milkborne Diseases. Report of Committee on Communicable Diseases Affecting Man. J. G. HARDENBERG. 25th Ann. Report of Intern. Assoc. Milk Sanitarians, p. 120, 1936.

There has been no definite trend in recent years in milkborne epidemics (since 1923).

However, in the past five years the number of deaths reported have averaged less than one per epidemic, whereas prior to that the ratio of deaths to epidemic was 1.3 to 1.

In 1935 there was a total of 43 milkborne epidemics reported in the United States and 2 in Canada. With a total of 1846 cases and 21 deaths.

Typhoid fever and spetic sore throat were responsible for 58 per cent of the epidemics, 64 per cent of the cases and all of the deaths.

The majority of the epidemics in the U. S. occurred in small communities; 27 were in towns of less than 5,000 population, 10 in towns of 5,000 to 25,000, four in cities of 25,000 to 50,000 and only two in cities of more than 100,000.

Raw milk as usual was the chief offender.

Pasteurized milk was involved in five cases but in three of them some raw milk was also consumed and in two of them the supplies were improperly pasteurized.

In addition to the cases reported above, there were 1936 cases of undulant

fever reported in the U. S. cause undetermined, however. In Canada there were 124 cases a large percentage of which were traced to milk from herds containing animals having Bang's disease.

Great progress has been made in developing safe wholesome milk supplies. In continuation of this program our efforts should be directed to:

1. Education of the consuming public to the importance of clean and healthful milk in the diet of individuals of all ages.

2. Education of dairymen to their responsibility and importance of their part in producing wholesome milk.

3. Promotion of pasteurization wherever feasible in order to bring the "greatest protection to the greatest number" of fluid milk consumers. At the same time we should not be blind to the faults of pasteurization, but should work for their correction.

4. Greater attention to the problem of safeguarding milk supplies in small communities and rural sections.

5. Recognition and encouragement of the efforts of the dairy industry in building desirable qualities into milk; such as greater nutritional values, qualities which are influenced by factors that go beyond the strict limits of hygiene and sanitation. L.H.B.

238. Tuberculin Testing and the Courts. JAMES A. TOBEY, The Borden Co., New York. 25th Ann. Report of Intern. Assoc. Milk Sanitarians, p. 95, 1936.

The first court decision upholding the tuberculin test was handed down by the Supreme Court of Minnesota in 1896.

Since this first decision on tuberculin testing, the United States Supreme Court and the courts of last resorts in a number of states have sustained the validity of municipal ordinances or board of health regulations requiring the tuberculin testing of cattle and the freedom of cows from this disease.

A total of some 35 references to court decisions are cited. L.H.B.

FEEDS AND FEEDING

239. Biological Value of Casein as a Supplement to the Proteins of Barley in Ratios for Pigs. E. H. HUGHES, California Agr. Exp. Sta. Jour. Agr. Research, *55*, 6, p. 461, Sept. 15, 1937.

It was noted that young pigs grow slowly on a ration in which barley was the sole source of protein. Feeding experiments showed that the addition of commercial casein to this ration at the rate of 1.5 per cent about doubled the growth rate and increased the gains per unit of feed consumed. However, when commercial casein was washed free of lactoflavin its addition to the ration produced no better growth than the ration in which the proteins were furnished solely by barley. Supplementing of the barley action with lactoflavin was not tried. L.M.T.

HERD MANAGEMENT

240. Shorten the Barn Feeding. C. F. MONROE, Ohio Agr. Exp. Sta. Weekly Press Bull. 22, 51, Feb. 24, 1938.

Dairymen can shorten the barn feeding period from 1 to 2 weeks by properly fertilizing some of their permanent pasture and turning their cows out earlier. W.E.K.

ICE CREAM

241. Which Test Gives the Most Accurate Fat Determination for Ice Cream. FORREST C. BUTTON, Rutgers Univ., New Brunswick, N. J. J. Milk Tech. *1*, 1, p. 30, Oct., 1937.

The author states that "there is still no agreement on the part of scientific workers as to the reliability of any of the modified fat tests for ice cream." L.H.B.

242. Ice Milk. F. W. MILNER. Ice Cream Field *31*, 2, p. 25, 3, p. 25, July-Aug. 1937.

The author gives the results of observations on the use of ice milk in milk shakes. In attempting to arrive at the most satisfactory basis of using ice milk in such drinks he prepared milk shakes by adding the same weight of ice milk which had been frozen so as to have widely different overruns.

It was found that the use of low overrun ice milk gave higher viscosity milk shakes than the use of high overrun ice milk even though the same weights were used in both cases. Also that the volume of the prepared drink was greater when low overrun ice milk was used in its preparation than when the same weight of high overrun ice milk was employed.

The author also reports comparative costs of milk shakes made with ice milk varying in overrun. W.C.C.

243. Quality Control in the Ice Cream Plant. H. F. JUDKINS, Sealtest System Lab., Inc., New York. 25th Ann Report of the Intern. Assoc. Milk Sanitarians, p. 290, 1936.

This paper discusses essential factors in the manufacture of high grade ice cream.

Plant, equipment, materials, manufacturing methods, personnel, etc., are included. L.H.B.

244. New Problems in Ice Cream Sanitation Committee Report. F. W. FABIAN, 25th Ann. Report of Intern. Assoc. Milk Sanitarians, p. 330, 1936.

This is a committee report and mention is made of some of the problems

fever reported in the U. S. cause undetermined, however. In Canada there were 124 cases a large percentage of which were traced to milk from herds containing animals having Bang's disease.

Great progress has been made in developing safe wholesome milk supplies. In continuation of this program our efforts should be directed to:

1. Education of the consuming public to the importance of clean and healthful milk in the diet of individuals of all ages.

2. Education of dairymen to their responsibility and importance of their part in producing wholesome milk.

3. Promotion of pasteurization wherever feasible in order to bring the "greatest protection to the greatest number" of fluid milk consumers. At the same time we should not be blind to the faults of pasteurization, but should work for their correction.

4. Greater attention to the problem of safeguarding milk supplies in small communities and rural sections.

5. Recognition and encouragement of the efforts of the dairy industry in building desirable qualities into milk; such as greater nutritional values, qualities which are influenced by factors that go beyond the strict limits of hygiene and sanitation. L.H.B.

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confronting the Health Official regarding counter freezers, pasteurization, and sterilization of equipment. Also fountain sanitation is discussed. L.H.B.

Other abstracts of interest are numbers 227, 230, 234, 237, 238, 245, 253, 262, and 263.

MILK

245. Investigation of the Amylase and Phosphatase Tests as an Indication of Pasteurization. F. W. Gilcreas and W. S. Davis, Div. of Lab. and Research, N. Y. State Dept. of Health, Albany, N. Y. 25th Ann. Report of Intern. Assoc. Milk Sanitarians, p. 16, Oct., 1936.

A study of the amylase test as described by Leahy made on 87 sample showed the test was accurate in 59 per cent of the cases in determining accurately the treatment received by the sample.

Conclusions were that the amylase test could not be relied on to detect accurately the degree of treatment.

The authors used and were much favorably inclined toward the Kay and Graham procedure for the phosphatase test. L.H.B.

246. Homogenization as a Preventive of Oxidized Flavor. Harold E. Ross, Cornell Univ., Ithaca, N. Y. Milk Plant Mo. *26*, 4, p. 36; 8, p. 40, April-May 1937.

Experimental evidence is presented showing the effectiveness of homogenization as a means of preventing the development of copper induced oxidized flavor in milk and cream. Low homogenization pressures of 500 and 1000 pounds per square inch were partially effective, but for positive results higher pressures were necessary. The development of the oxidized flavor was prevented entirely by homogenization at pressures of 1500 pounds per square inch and above. These pressures were equally effective in preventing the development of the off flavor when copper was added to the milk after homogenization.

Tables are presented giving details of all the experiments. The author advances a theory explaining in part why milk properly homogenized does not develop an oxidized flavor. G.M.T.

247. The Oxidized Flavor in Milk from the Individual Cow. C. D. Dahle and L. S. Palmer, Penn. Agr. Exp. Sta. Bul. 347, May, 1937.

The spontaneous oxidized flavor in milk is considered to be due to the oxidation of the phospholipid fraction of the fat globule membrane (lecithin) and the butterfat. It was determined that the enzyme-like factor responsible for off-flavor is carried in the plasma and serum portion of the milk, but that it is not responsible for the reduction of vitamin C content. The develop-

ment of oxidized flavor in milk is greatly inhibited by feeding green foods, incubation at 98° F., pasteurization above 168° F., the removal of oxygen or by the additions of vitamin C, hydroquinone, and oat flour. Pasteurization between 145–160° F. and exposure to sunlight enhance the off-flavor. Storage of susceptible samples at 40–45° F. caused a decrease in vitamin C content, but less in milks heated to 170° F. W.D.S.

248. Report of the Committee on Dairy Farm Methods. F. D. HOLFORD, 25th Ann. Report of the Intern. Assoc. Milk Sanitarians, p. 303, 1936.

This report discusses information an inspector should have, also the following fundamentals: general conditions, health of cows, utensils, milking, milk house and cooling. L.H.B.

249. Methods of Improving Milk Supplies in Small Communities. LESLIE C. FRANK, 25th Ann. Report of Intern. Assoc. Milk Sanitarians, p. 347, 1936.

This paper gives a very thorough report on the status of milk control in municipalities of 1000 to 10,000 population. L.H.B.

250. Milk Control in Small Communities on a Mandatory versus A Voluntary Basis. C. A. ABELE, State Dept. of Health, Montgomery. 25th Ann. Report of the Intern. Assoc. Milk Sanitarians, p. 382, 1936.

Gives reasons why he thinks milk control in small communities will prove more satisfactory on a voluntary basis and that this method has several distinct advantages over the policy of mandatory compliances. L.H.B.

251. Experiences in Meeting Milk Flavor Problems. C. L. ROADHOUSE, Univ. of California. 25th Ann. Report of Intern. Assoc. Milk Sanitarians, p. 201, 1936.

A discussion of normal constituents of milk influencing taste. The chloride-lactose relation is believed to be most concerned with the natural pleasant flavor of milk.

Feed flavors, rancidity, oxidized flavor, and influence of sunlight are also discussed. L.H.B.

252. The Influence of the Ration on Milk Flavor. J. A. ANDERSON, Bureau of Biol. Res., Rutgers. Univ., New Brunswick, N. J. 25th Ann. Report of the Intern. Assoc. Milk Sanitarians, p. 223–238, 1936.

Observations over a period of months on two large farms producing high grade milk indicated that certain food accessories of the feed had an important bearing on the flavor development in milk after two to four days of storage. In one herd very few cows produced milk which acquired an off

flavor on storage, while in the other many cows produced such milk. Both herds received approximately the same kind of feeds, however, the one wherein the least trouble with off flavor was experienced received machine cured alfalfa hay while the other herd was fed field cured alfalfa.

Other investigators have demonstrated that machine dried alfalfa contained approximately as much carotene as did fresh alfalfa, while three days of field curing caused a loss of nine tenths of the carotene.

Substituting field cured alfalfa for machine cured alfalfa in the ration of a cow giving rancid milk had a decided effect in increasing both the intensity and frequency of flavor development. Again feeding machine cured in place of field cured alfalfa again lessened this flavor development.

Carrots (2 to 3 times richer in carotene than fresh alfalfa) were also fed with excellent results in reducing rancid flavors.

Feeds rich in carotene were also found beneficial in preventing and lessening oxidized flavor developing in milk.

Feeds rich in vitamin C (fresh cabbage) had no beneficial effect in preventing oxidized flavors. L.H.B.

253. The Scope of the Milk Sanitation Studies of the Public Health Service. LESLIE C. FRANK, Office of Milk Investigations, U. S. Public Health Service, Washington, D. C. 25th Ann. Report of Intern. Assoc. Milk Sanitarians, p. 191, 1936.

During the past ten years the milk sanitation studies of the Public Health Service have included projects designed to answer the following questions:

1. How frequently do milk borne outbreaks of disease occeur?

Since 1923 an annual questionnaire has been sent to health officers of all municipalities of 10,000 population and over. These surveys indictae that the average for the past 10 years is at least 43.5 milk borne outbreaks per year.

2. To what extent do American communities attempt to control milk supplies, and to what extent are their citizens protected by such major measures as pasteurization, tuberculin testing, abortion testing, ets.?

From 1927 to 1931 in municipalities of 10,000 or over, pasteurization of milk supplies increased from 81.8 per cent to 87.5 per cent. Milk from tuberculin tested cows increased from 68.1 per cent to 88.7 per cent in the same period of time.

3. How can process of pasteurization be tested to determine whether they are effective, and how can the efficiency of various types of pasteurization be compared with each other.

No apparatus should be approved that shows a temperature deviation greater than 1° F. Tests conducted on 160° F. for 15 sec. and 142° F. for 30 minutes gave assurance that either method would prevent milk borne outbreaks of disease, however, no answer is available as to which of the two methods gives the greater factor of safety.

4. How can processes of germicidal treatment of dairy and milk plant equipment be tested to determine whether they are effective, and how can the efficiency of various processes be compared?

This question is being studied. Heat methods are being compared with chemical methods. Each chlorine compound is to be tested with a test organism to determine the number of parts per million required to produce a standard percentage killing of a standard concentration in a standard time, at a standard temperature, at a standard pH, and with a standard temperature, and with a standard concentration of organic matter.

5. How should pasteurizer inlet and outlet valves be designed?

Some of the results of this study are now contained in the Public Health Service Milk Code. A more detailed publication is contemplated.

6. Are air and foam heaters necessary and how should they be designed?

Milk foam is nearly always insufficiently pasteurized. A publication on these studies is contemplated.

7. What is the cost of strictly enforcing the Public Health Service Milk Ordinance?

The mean cost reported by 74 cities which were strictly enforcing the ordinance as shown by ratings of 90 per cent or higher, was 8.3 cents per capita per year or one-half cent per gallon.

8. Does pasteurization significantly affect the food value of milk?

This study was undertaken several years ago and the results for children ten months to six years of age showed that the growth promoting capacity of milk is not significantly affected by pasteurization or other heating.

9. What is the public health significance of keeping milk cold in the home?

This study has been completed and the publication is ready for distribution.

10. Can the Public Health Service milk ordinance be successfully applied to a very large city?

During the past ten years the ordinance has been adopted by larger and larger cities. In 1935 it was adopted by Chicago and a study of the progress is being closely made there. Studies to date seem to indicate the results will be successful. If so, this should finally settle the question as to whether the Public Health Service milk ordinance is sufficiently flexible to be adapted to population groups varying in size from less than 10,000 to more than 3,000,000. L.H.B.

254. A Study of Milk from Apparently Normal Udders. C. K. JOHNS, Central Exp. Farm, Ottawa, Canada. 25th Ann. Report of Intern. Assoc. Milk Sanitarians p. 145, 1936.

A study was made of heifers giving foremilk of abnormal composition from apparently normal udders.

High values for catalase, chlorides, and pH in the foremilk do not always indicate infection with mastitis streptococci or other specific pathogens.

A positive diagnosis should be based primarily on the demonstration of the causative organism. L.H.B.

255. Milk Control in Pennsylvania. WILBUR K. MOFFETT, State Dept. of Health, Harrisburg, Pa. 25th Ann. Report of Intern. Assoc. Milk Sanitarians, p. 165, 1936.

Pennsylvania revised its milk control law by the State Department of Health inviting the cooperation of the local health officers, the milk dealers, the ice cream manufacturers, the medical associations and any other organizations which were interested in health measures. We tried to take the best ideas from those used in New York, New Jersey and other states and incorporated them in the Pennsylvania regulations, known as Act 210, which was signed by the Governor, July 2, 1935.

We still have a system of approved inspectors but standards for these inspectors have been raised. There are about 350 of these approved inspectors and they are hired by the plants. To obtain a certificate as an approved inspector, they must have some technical training, some practical training, a lot of common sense, and good moral character, besides passing an examination which is not given out in advance. These men are supervised by 28 state inspectors.

Before milk, or any dairy product, or ice cream or any product that goes into ice cream can be sold in Pennsylvania, the dealer, at his own expense, must put in shape his own supply to meet the requirements of the state. After that is done, he makes an application. The state then sends men to check on the work of the approved inspector, and in case of new applications to do business in the state it means a 100 per cent check on every farm that is shipping to that plant. That means that all butter used in ice cream must come from an inspected source. Also all evaporated milk used in Pennsylvania must come from an inspected source.

All raw milk producers are inspected by the Department of Health and not by approved inspectors. L.H.B.

256. The Use of Resazurin in Determining the Bacterial Quality of Milk and Cream. J. N. WARNER, Iowa State College, Ames, Iowa. Dairy World *16*, 9, p. 18, Feb., 1938.

In a comparison of the resazurin test with the methylene blue test, utilizing methylene blue chloride and methylene blue thiocyanate and reading the resazurin tests at the violet, pink and white stages, the following conclusions were drawn. The resazurin test offers no advantage over the methylene blue if resazurin-white is used as the end point. The resazurin-pink and resazurin-violet reduction times are considerably shorter than the methylene blue but classification of samples does not parallel the latter test. Whether the difference would result in a more desirable classification or a less desirable classi-

fication is not shown in the data obtained. The resazurin test showed no advantage over the methylene blue test for use with pasteurized milk or cream or ice cream mix. F.J.D.

257. Some Factors Affecting the Accuracy of the Babcock Test on Composite Samples of Milk. C. W. ENGLAND AND G. D. D'AMBROGI, Univ. of Maryland, Agr. Exp. Sta., College Park, Md. Bull. 413, Oct., 1937.

Composite samples of milk were prepared by making daily additions of 10.4 ml. each. Those samples were held for seven, ten and fifteen days at 45°, 60°, 80° and 100° F. and were preserved by one mercuric chloride tablet (0.48 gram tablet containing 46.66 per cent $HgCl_2$). Composite samples were also prepared with one-half, one and two mercuric chloride tablets and held at 60° and 100° F. for seven, ten and fifteen days. Fresh samples were tested daily and their average test compared with the tests of all composite samples.

Samples of milk were brought to a definite volume by adding 156 ml. to each sample bottle, the sample then being tested immediately for fat content. These samples were held at 45°, 60°, 80° and 100° F. for seven, ten, and fifteen days, and were preserved by one mercuric chloride tablet. Samples brought to a constant volume were also preserved with one-half, one, and two mercuric chloride tablets and held at 60° and 100° F. for seven, ten, and fifteen days. The fresh sample tests were compared with the tests of all preserved samples.

All tests were made by the Babcock Method. A summary of results follows:

1. The fat tests on all composite and preserved sample, regardless of the length of time held, averaged lower than the fresh sample average test. As the time of holding is increased the resulting fat test is decreased.

2. The fat tests on all composite and preserved samples, regardless of the temperature held, averaged lower than the fresh sample average test. As the temperature of holding is increased, the resulting fat test is decreased.

3. Samples preserved by one mercuric chloride tablet gave the highest, one-half tablet the next highest, and two tablets the lowest fat tests. This holds true for all periods of time at both 60° and 100° F. Regardless of the amount of mercuric chloride used, all tests on composite and preserved samples were lower than the fresh sample test.

The average of all fresh sample tests was 4.355 per cent. The average test of all composite and preserved samples held for seven and ten days at 45° and 60° F. using one mercuric chloride tablet was 4.302 per cent. Thus it may be stated that when preserved samples were held under excellent conditions, the fat test averaged 0.053 per cent lower than the true fresh sample test.

The average test of all composite and preserved samples held for fifteen

days at 45° and 60° F. using one mercuric chloride tablet was 4.275 per cent, or 0.080 per cent lower than the true fresh sample average.

The average test of all composite and preserved samples held at 80° and 100° F. using the mercuric chloride tablet was 4.188 per cent, or 0.167 per cent lower than the true fresh sample average. C.W.E.

258. Salvaging Return Milk. ANONYMOUS. Milk Dealer 27, 4, p. 44, Jan. 1938.

A brief summary of how some dealers, in localities which permit milk to be returned to the routes the second day, are eliminating the loss on returns by the use of refrigerated delivery trucks. A cross section of replies received from various sections of the country regarding the use of returns is also given. C.J.B.

259. Report of the Committee on the Food Value of Milk and Milk Products. G. C. SUPPLEE, Bainbridge, N. Y. J. Milk Tech, *1*, 1, p. 16, Oct. 1937.

A brief summary of the findings of various investigators on factors effecting the food value of milk. L.H.B.

260. Engineering of Pasteurization. C. A. HOLMQUIST AND W. D. TIEDEMAN, State Dept. of Health, Albany, N. Y. J. of Milk Tech. *1*, 1, p. 11, Oct. 1937.

Some of the faults of old type pasteurizers are cited, and how these have been eliminated by dairy engineers in testing, and redesigning equipment so that equipment is now available that will pasteurize milk with a full factor of safety. L.H.B.

261. The Resazurin Test—Preliminary Studies on Its Practicalities and Possibilities. J. A. KEENAN, W. D. BARRETT, AND H. RUTAN, Whiting Milk Co., Boston, Mass. J. of Milk Tech. *1*, 1, p. 22, Oct., 1937.

The authors concluded that the resazurin test will impart more information concerning the quality of milk in one hour's incubation than will the methylene blue test in six hours' incubation.

The test is more sensitive to abnormal milks (colostrum and mastitis milks) than is the methylene blue test. L.H.B.

Other abstracts of interest are numbers, 225, 230, 233, 234, 235, 236, 237, 238, 262, 263, and 264.

MISCELLANEOUS

262. Report of Committee on Milk Plant Practice. A. R. TOLLAND, 25th Ann. Report of Intern. Assoc. Milk Sanitarians, p. 181, 1936.

With but one exception all members of the committee replying on the question of bottling orange juice in milk plants the practice should be forbidden. A number of states and cities require that orange drinks be processed in equipment (or rooms) not used for handling fluid milk.

Reconstructed dairy orange beverages rapidly lost their vitamin C content on standing at room temperature. The loss at cold storage temperature is much less but is still considerable. L.H.B.

263. Vitamin C Content of Dairy Orange Beverages. M. J. Mack, C. R. Fellers, W. A. Maclinn and D. A. Dean, Mass. Agr. Exp. Sta., Amherst, Mass. 25th Ann. Report of the Intern. Assoc. of Milk Sanitarians, p. 267, 1936.

Chemical methods for determining vitamin C content of orange beverages were found to agree closely with the biological assay method.

Twelve samples of ten different dairy orange beverages were found to contain from 0.2 to 53.0 units of vitamin C per ounce.

Fresh orange juice contained 228 to 258 units per ounce; while canned orange juice had slightly over 200 units per ounce.

Reconstituted dairy orange beverages lose their vitamin C very rapidly at room temperature, usually about 60 per cent in 20 hrs. At 40° F. the loss was 15 per cent or more in the same time. In two days the loss was even greater; yet many dairies do not make up the product daily. L.N.B.

264. The Physician and Our Daily Bread. American Institute of Baking, 9 Rockefeller Plaza, New York, N. Y. Pp. 19, 1938.

Although this booklet is devoted to the subject of bread and its proper place in normal and reducing diets, there are many allusions to milk in it. Thus, it is stated that practically all white bread now contains at least 6 per cent skimmilk solids, which enhance the nutritive properties of the loaf by adding proteins, minerals, and certain vitamins. Several pages of sample daily menus for use in reducing diets are prefaced by the statement that "a pint of certified or pasteurized milk, or its equivalent in other dairy products, is desirable in all daily reducing diets." Bread is recommended in these diets as a necessary source of the carbohydrate needed for the most efficient burning of body fat. This pamphlet is accepted by the Council on Foods of the American Medical Association. J.A.T.

Another abstract of interest is number 235.

PHYSIOLOGY

265. Fat Feeding and Cholesterol Absorption. Robert Percival Cook, Biochem. Lab., Cambridge, England. Biochem. J. *31*, 410, 1937.

In a previous study it was observed that with growing rats cholesterol is absorbed only in the presence of free fat in the diet, a cholesterol "fatty" liver being induced solely under these conditions. In this study the experiments were conducted to determine the effect of the amount of fat on cholesterol absorption. Growing rats were fed on diets containing 15, 20 and 30 per cent fat (arachis oil) with and without 2 per cent cholesterol. Cholesterol was observed to have a deleterious effect on the growth rate, which was most marked with the 15 per cent fat diet. This affect is, during the first few weeks probably due to the reduced food intake of the animals, after which period the rats adapt themselves to the ration. The absorption of cholesterol is not increased by raising the fat concentration in the diet. Approximately 30 per cent of the cholesterol fed remains unaccounted for, as determined by unsaponifiable fractionation of the faeces and the animals' bodies.

K.G.W.

266. A Study of the Effect of Overfeeding on the Protein Metabolism of Man. I. The Effect of Superimposing Raw and Boiled Milks on a Diet Adequate for Maintenance. II. The Superimposition, on a Diet Adequate for Maintenance, of Beef (or Soya Flour) Plus Lactose Plus Butter, Equivalent in Protein, Carbohydrate and Fat Content to a Liter of Milk. D. P. CUTHBERTSON, ALEXANDER MCCUTCHEON AND H. N. MUNRO, Institute of Physiology, Univ. of Glasgow, Scotland. Biochem. J. *31*, 681, 1937.

Seven subjects of good physique, members of the teaching or laboratory staff, were given self-selected basal diets including 500 ml. raw milk, with a constant water intake. After the nitrogen equilibrium had been determined for each of the subjects, the diet was superimposed by one liter of either raw or boiled milk. This was conducted both in one day and 8 day tests. Superimposition of a liter of either raw or boiled milk on the diet, adequate for maintenance of body weight and nitrogen equilibrium in the adult human subject, caused an increase in body weight and a marked retention of nitrogen and sulphur but not of calcium. No significant difference could be observed in the metabolic fates of the proteins of raw and boiled milks. When sodium caseinate equivalent in nitrogen to the added liter of milk was substituted in the diet of one subject, the retention of nitrogen was definite, but not of the same magnitude as for milk.

The superimposition of beef plus lactose plus butter equivalent in protein, carbohydrate and fat content to a liter of milk also effected a definite saving of food nitrogen. Soya flour plus lactose plus butter gave similar results.

K.G.W.

JOURNAL OF DAIRY SCIENCE

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The American Dairy Science Association was organized to advance the general welfare of the dairy industry, especially by the improvement of dairy instruction by the stimulation of scientific research in all phases of the subject and by improvement in methods of conducting extension work.

Membership shall consist of two kinds: (1) active, (2) associate.

The qualifications for membership in the two classes are as follows: (a) Any person is eligible to active membership who is formally announced by an Agricultural College, or Experiment Station, or by the Bureau of Dairying of the United States Department of Agriculture as an instructor, extension worker, investigator, or administrative officer connected with the dairy industry, or (b) anyone filling a position of responsibility connected with the dairy industry and who has had a college or university training in technical science, or anyone filling a responsible position in the industry of a professional character requiring a technical knowledge of dairying of a high order.

Any person is eligible to associate membership who is regularly enrolled in a collegiate course in a College of Agriculture and who is specializing in dairying. Associate membership is attained by election to membership in a local chapter of *The American Dairy Science Association.*

The dues are $5.00 a year for active membership. Correspondence regarding membership and dues should be addressed to R. B. Stoltz, Ohio State University, Columbus, Ohio.